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Next Week – Robert Livermore on the Smuggler Union Enterprise

518 ft. of 6'x12' Shaft in 62 days

Part of the sinking crew with their DCRW-23 "Jackhamer" Drills.

THIS RECORD has just been made at the Ventura mine in the Santa Eulalia district, Chihuahua, Mexico.

It is a splendid achievement when one considers that the period of 62 days included not only the shaft sinking, but also the timbering for the entire distance and the placing of guides, ladders, staging, and pipe line bearers.

Credit for this record goes to W. E. Johnson, contractor of Las Cruces, New Mexico and his efficient crew, part of whom are shown above. All drilling was done with Ingersoll-Rand DCRW-23 "Jackhamers." Not one cent was spent on repairs for these drills during the entire job.

This mine is controlled by Lake Superior interests. Mr. H. C. Dudley of Duluth is Pres.; R. H. Bennett of Minneapolis, Vice Pres.; W. N. Fink of Cusihuiriachic, Mgr.; Roy Chapman of Santa Eulalia, Supt.

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Patenting a Mining Method

FEW of the patents that fill the pages of the *Patent Gazette* have to do with underground mining practice. It came as a surprise to many, no doubt, when the *Gazette* of July 22, 1924, announced that patents on two different mining methods had been granted, one to Edwin Ball and C. E. Abbott, of the Birmingham district, Alabama, and the other to S. J. Goodney, of Crystal Falls, in the Michigan iron country. The first of these patents covered a method involving the respective steps of driving a main slope beneath an inclined seam or deposit, turning levels laterally from it in the deposit, driving manways in advance of and parallel to the main slope, connecting these by levels in advance of the slope, and then raising the slope from the levels. The purpose of the joint patentees, who were employees of the Tennessee Coal, Iron & Railroad Company, may only be surmised. The method patented had its advantages, particularly in that it permitted the determination of the character of the ground in advance of the slope and so made it possible to select the proper stope interval more accurately.

The other of the two patents covered a method of mining soft ore, which involved sinking on the vein, crosscutting from the bottom of the shaft, raising vertically from the crosscut, opening a sublevel communicating with the raise, and then opening a second similar sublevel at a different elevation from and out of alignment with the first sublevel, in this way relieving the portion of the ore adjacent to the sublevels from too great a strain.

What value these patents held for the inventors is problematical. Commercially, they probably had but little worth. Protection for the company employing the patentees was most likely the end in view.

To this short list of patents on mining practice may be added a third, announced in the *Gazette* of March 6, 1928. This is U. S. Patent No. 1,661,238, granted to John Sloan, of Johannesburg, South Africa, and covering a rock pack of the "pigsty" type for supporting mine workings. The pack consists of a skeleton metal or wire cage, of any cross-sectional shape or area, for holding filling material in position until it takes the pressure or weight of the hanging wall or roof of the working. Its purpose is to provide a more efficient and cheaper type of pack than those previously devised. It may be regarded as one result of the extensive study given to the problem of supporting mine workings on the Rand.

This problem has increased in importance as the workings of the Rand gold mines have become more and more extensive with the passing years. Development work done to date is close to 4,000 miles and the area excavated is proportionately large, according to a recent issue of the *Mining and Industrial Magazine of South Africa.* Gradually a new technique in supporting the hanging wall has developed in the mines of the Far East Rand, the publication states—a technique which depends in the main upon the use of concrete. " 'Cribs' were succeeded by 'columns,' or 'monoliths,' and now monoliths have been largely displaced by 'disks,' 'biscuits,' or 'pancakes' (all of concrete)," it says. The newly patented pack is evidently but a step in this development.

The majority of mining methods have gone unpatented, no doubt, because in most instances they have developed so slowly that at any stage it has been difficult to perceive which of their features were really new and which were old and common knowledge. Moreover, it would be difficult for an individual to find a way to profit from such a patent, as anyone having experience with patents might surmise. On the other hand, a company employing a method of limited application, and by it producing a large tonnage, might find itself inconvenienced should someone not under its control obtain a patent on the method. With such a contingency in view, the company might think it desirable to secure a patent as a protection.

Generally speaking, it is as permissible to patent a new method of extracting ore as to obtain similar protection for any new invention, but we doubt if it is as easy. It is hard to demonstrate the novelty of any mining method—so much so that to secure a patent on one may be considered an achievement.

Brevity Versus Verbosity

SPEAKING to a radio audience recently, Mr. Harold M. Anderson, of the editorial staff of the New York *Sun,* quoted a contributor who was "shamed by his verbosity." He apologized, saying, "I am sorry to give you a long article; I did not have time to write a short one."

How many realize that brevity may indicate the maximum of effort on the part of the author; that, in conjunction with an absence of ambiguity or omission, it may constitute the best evidence of good writing? The author or an editor may spend a few hours to condense a manuscript 5 per cent, but this may save twenty thousand hours of profitless reading by others, in addition to enhancing clarity. Lafcadio Hearn once said that "To produce even a single sentence of good literature requires that the text be written at least three times." Good writing and hard work are inseparable.

Mr. Anderson remarked that "A reader who will pass over—to his serious moral and mental detriment—an article of 1,500 words, will avidly consume five articles of 300 words each. When he has done this he will look for more. He may even be tempted to read a long article." A magnificent example of forceful composition is afforded by the well-known Anderson editorial that appeared in the *Sun,* entitled "Lindbergh Flies Alone."

It is worthy of study, to illustrate the force and aesthetic charm inseparably associated with brevity. Mr. Anderson's masterpiece of writing follows, in full:

"Alone?

"Is he alone at whose right side rides Courage, with Skill within the cockpit and Faith upon the left? Does solitude surround the brave when Adventure leads the way and Ambition reads the dials? Is there no company with him for whom the air is cleft by Daring and the darkness is made light by Emprise?

"True, the fragile bodies of his fellows do not weigh down his plane; true, the fretful minds of weaker men are lacking from his crowded cabin; but as his airship keeps her course he holds communion with those rarer spirits that inspire to intrepidity and by their sustaining potency give strength to arm, resource to mind, content to soul.

"Alone? With what other companions would that man fly to whom the choice were given?"

Shall the Small Industrial Unit Survive?

A THOUGHTFUL ARTICLE, by Mr. J. H. Williams, on the subject of industrial consolidations and combinations, appears in the current issue of the *Atlantic Monthly,* in which the author avers that an impartial investigation might well show that many mergers that have seemed necessary under past conditions of legislative restriction would have been unnecessary and unwise if based on the operation of natural law. The fact is emphasized that the majority of combinations result from the necessity for price stabilization. The desire to preserve the smaller unit in industry has prompted the outcry against monopoly or oppression. The public was thinking, and still is, maintains Mr. Williams, "of preventing monopoly and the concentration of capital in the hands of the few; but the politicians and the courts have been telling us, in effect, until the public has come to believe it, that the way to accomplish that result is by preventing competitors from even discussing their most vital mutual problems, upon which their ability to continue to serve the public, nay, even their very existence, is often based. Never, surely," adds Mr. Williams, "has the intent of a legislative policy been so emasculated, or so subjected to what the uninformed laity may well term 'injudicial interpretation'"!

Cut-throat price competition, we are often told, is the life of trade. Is this based on the notion, Mr. Williams asks, "that goods shall reach the consumer as cheaply as possible, regardless of whether the producer or distributor is worthy of his hire?" On the other hand, "price fixing would operate chiefly to prevent demoralization when supply exceeded demand. . . . Stabilized prices mean stabilized wages; the two together mean stabilized purchasing power, which exercises an all-important influence upon the stabilization of business activity."

It is true that one need not sell below cost; but "every industry contains some who think they can take another's business away by price concession without suffering retaliation, and who will always think they can successfully produce what their competitor is alleged to be offering, while the law as now construed will not permit them to get the correct information until too late, if then." Those who wish to trace the underlying logic in the statement that the intention to raise prices does not prove intention to injure the public should refer to the article cited for a detailed account of the decision in the famous Australian Colliers case.

A valuable summary of American opinion on this phase of American policy is given by Mr. Williams. Judge Gary, for instance, agreed that co-operation must eventually take the place of competition and that such co-operation requires governmental supervision. Theodore Roosevelt, who condemned and did all in his power to suppress abuses of combination in business, said. "It is mischievous and unwholesome to keep upon the statute books unmodified a law like the anti-trust law, which, while in practice is only partially effective against vicious combinations, has nevertheless in theory been so construed as sweepingly to prohibit every combination for the transaction of modern business." More recently, in 1927, the American Bar Association's Committee on Commerce opined that "Lawful agreements are commendable. If fear of the law keeps men from entering into lawful contracts the public interest is violated. The Sherman law is the basis of such a fear to an extent that cannot be overstimated. . . . It is a power beyond the law . . ."

Finally, to reiterate what *Mining Journal* has already queried: "Are the interpretations of the Sherman and Clayton Laws," Mr. Williams asks, "so sacrosanct that their perpetuity must be conceded, that to challenge the economic wisdom of their application and the economic benefit of their execution one must incur the suspicion of malefaction?" Not the least incongruous and absurd phase of the propaganda to keep the small units in business apart, when it comes to the discussion of matters vital to their wellbeing if not of their existence, is the inference that any criticism of such legislative restriction is un-American and therefore unworthy. In time, let us hope, some more attackable argument will be adduced, or some effort be made to define beforehand the various catchwords and slogans that are repeated as being illustrative of the fixity of national policy in the face of changing domestic and international business conditions.

American Mining Engineers Abroad

MUCH HAS BEEN SAID recently about the years that Mr. Hoover spent in professional work in China, Australia, Burma, and Russia. The impression prevails in many quarters that his career in this respect was, if not unique, at least quite unusual. True enough, not many young engineers have been put in charge of important gold-mining operations as was Hoover at the age of 23. But since 1896, when as a young graduate from Stanford, Hoover was made manager in Western Australia for an important British mining group, the number of American mining engineers who have gone overseas each year has increased steadily. The names of scores of men more or less illustrious in the history of mining and metallurgy could be mentioned, many of whom played a part in overseas mineral development, particularly in Africa. In South America, and to a much less extent in other continents, mining enterprise has been financed largely by capital from the United States; and it is natural that the engineers and technicians in charge of such operations should be American. But companies controlled by nationals of other countries likewise have called upon engineers from the United States to direct their operations or assist in the solution of their technical problems. No more em-

phatic tribute to the high standard of American engineering and managerial skill could be paid. Incidentally, this matter is of interest to the manufacturer in the United States, for it is reasonable to expect that the inclination of these men will be to utilize equipment with which they are familiar and in the performance of which they have confidence.

Without pretending to make a complete catalog of those who recently have gone abroad to undertake engagements of this character, the following may be mentioned, as being among those whose travels have been chronicled in the *E. & M. J.:*

Mr. A. G. McGregor, who has been identified with the design and construction of most of the smelters built in recent years in the Southwest, has established an office in London, where he has several British clients that are to erect new metallurgical plants, notably in southern Africa. Mr. Walter C. Page, whose specialty is concentration, is associated with Mr. McGregor and is now in Africa. Mr. A. A. Zentner, formerly with the Anaconda company, went to London about two months ago on an engagement with the Chemical & Metallurgical Corporation, which is planning the erection of a leaching and electrolytic plant for the hydrometallurgical treatment of zinc concentrates.

At least three American engineers recently accepted positions involving residence in Africa. Mr. William Burns is manager for N'Changa Copper Mines, Ltd., which is to exploit one of the properties developed by Rhodesian Congo Border Concession; Mr. John E. Pemberthy, formerly with Phelps Dodge, is to be geologist for the Union Minière in the Katanga copper region; and Mr. Douglas Jessup, long with the United States Smelting, Refining & Mining Company, at Midvale, Utah, sailed last month to become assistant manager for the Broken Hill Mining Corporation, the big enterprise in Rhodesia dominated by the Anglo-American Corporation. Mr. F. L. Bosqui is engaged on a number of metallurgical problems for Rand Mines, Ltd., among them being the treatment of the refractory platinum ores from South Africa.

Mr. Archer E. Wheeler, consulting metallurgist from New York, who, incidentally, designed the new Noranda copper smelter, in the Rouyn district in Quebec, is in Russia conferring with Soviet officials regarding the proposed erection of new reduction works for copper ores. Mr. H. D. Laraway is in Russia supervising the erection of a concentrating plant for the Atbassar Metal Trust, whose copper ores are to be treated by flotation in a plant designed by the General Engineering Company at Salt Lake City.

Australasia claims the attention of several American engineers in the employ of British companies. Mr. H. Y. Eagle has gone to Tasmania to supervise the starting of the newly erected copper refinery of the Mount Lyell Mining & Railway Company, which was designed in New York. The Russo-Asiatic group, which has undertaken the exploitation of the extensive deposits of complex lead-silver ores at Mount Isa, has engaged a young American engineer to develop a procedure for the selective floating of the sulphides in the ore. Mr. L. K. Jacobsen was chosen for this important work because of his success at the Utah-Apex plant, at Bingham, Utah. Australia, with some justice, claims to be the birthplace of flotation, and later of selective flotation; accordingly, the fact that a British company comes to the United States to get a specialist is a compliment to American achievement in the art.

Other names could be added to the list; but the foregoing are enough to indicate the demand on the part of foreign companies for American technical talent and experience; and, though to a less degree, for business and administrative ability. Mining engineering ignores political subdivisions of the world, perhaps more than any other activity. For the American mining engineer at some time in his career to have worked outside the United States—and frequently for a foreign company—is the rule rather than the exception.

Tintic Standard Makes A Commendable Move

FOR SEVERAL YEARS the Tintic Standard Mining Company, Utah silver-lead producer, has been paying its stockholders $1.70 on each of the 1,152,915 outstanding shares. This was represented by four regular quarterly dividends of 20c., four extras of 20c. each, and a special Christmas distribution of 10c. At the meeting of the directors on March 7 it was decided to reduce the quarterly extra—which in the shareholders' minds had become a "regular"—to 10c. The change goes into effect with the first-quarter dividend payable on March 29. On the new basis the annual rate, assuming the payment of the Christmas bonus, will be $1.30 per share.

Net earnings for 1927, after all deductions and provision for depreciation, were $1,824,496, equivalent to $1.58 per share. The average price for lead during the year was 6.74c. per pound, or considerably higher than the price that has prevailed in recent months. Consequently, the rate of current earnings is measurably lower than the average of 1927. Incidentally, it should be noted that one-third of the company's income is from silver, so that earnings are not entirely dependent upon the health of the lead market.

The directors, however, were faced with three possible courses of action: (1) To expand production, which doubtless could have been done so far as the physical condition of the property is concerned; (2) to continue the dividend rate by dipping into the satisfactory surplus that has been accumulated in recent years; and (3) to reduce the dividend rate. The objection to the first course was that increased production would merely throw additional lead on a market that for the present is oversupplied, with a consequent tendency to depress the price still further. Instead, the company *decreased* the rate of mine production, a curtailment of 100 tons of ore per day having been put into effect on Feb. 1.

The objection to the second course seems equally sound. The company is engaged in extensive exploratory and development operations that it does not desire to curtail. No one can predict with reasonable assurance that an early improvement in the price for lead is likely. Under the circumstances, encroachment on the surplus in the treasury to pay dividends would establish a policy that would be difficult to change when once started. The directors preferred to face the issue now, and to adjust the dividend rate to current income. In every respect the course chosen should work in the long run to the best advantage of the metal-mining industry at large and—as is more important to the Tintic Standard officials—of the shareholders of their company.

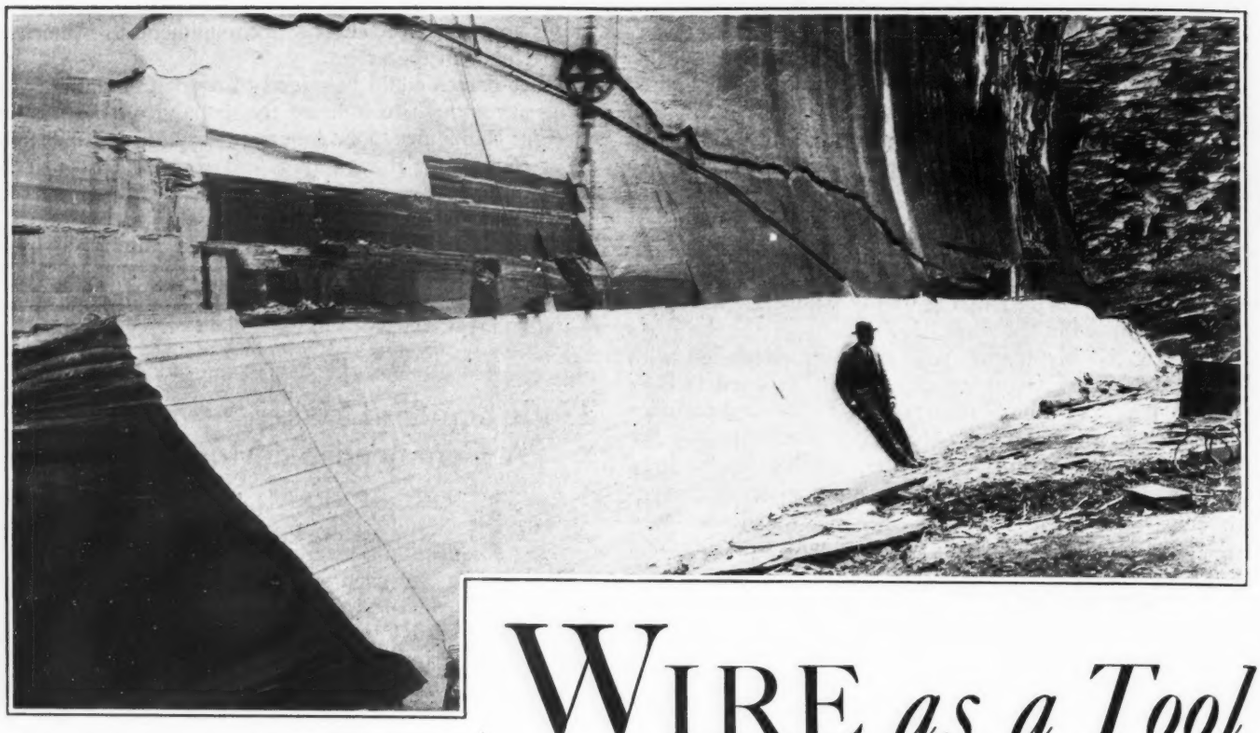

Fig. 1—A wire-cut surface at the Jackson-Bangor quarry. The cut is 95 ft. long and is inclined at 52 deg.

WIRE *as a Tool for* MINING

DISTINCT SUCCESS recently has been attained in cutting Pennsylvania slate from its natural beds with wire saws. Experiments initiated by the Non-metallic Minerals Experiment Station of the U. S. Bureau of Mines have given such promise of low-cost operation and waste reduction that at least six companies are now using the saws in their quarries.[1]

A realization of the heavy waste of materials in quarrying and manufacturing slate, a waste that reaches 70 to 94 per cent of gross production, led the Bureau to urge upon operators the advisability of experimenting with the wire saws as a means of avoiding waste and reducing the cost of production. Active co-operation was obtained from several Pennsylvania slate companies, and the experimental work resulting therefrom is briefly recorded in this article.

The wire rope as a hoist cable or as a guy wire to support masts and derricks is a familiar type of equipment around mines and quarries, but the use of a wire cable as a tool for cutting rock is an unusual application. Essentially, the wire saw is a three-strand wire cable running as an endless belt. This cable takes the place of the saw blade, and the teeth of the saw consist of sand grains carried in the spiral grooves formed by the winding of the wire strands.

For an average cut 60 to 100 ft. long a wire 700 to 1,000 ft. in length is used. It is carried by guide pulleys from the driving unit to the particular place in the quarry where a cut is desired. Here the wire is brought in contact with the slate, and is drawn across it while held forcibly against it. Sand is automatically fed to the saw through trough-shaped boxes, using a small stream of water as a conveyor. As the sand is carried against the moving cable it is caught in the grooves and carried along. The sand is thus forced against the rock and dragged along with the cable, wearing away the rock particles where pressure of the wire is exerted. This results in rapid abrasion, forming a cut about $\frac{1}{4}$ in. in width, which is only slightly wider than the diameter of the cable.

Orienting pulleys are carried on standards at either end of the cut. The lower pulley is movable and at intervals is fed downward with a rope feed operating a worm gear on a threaded shaft, as shown in Fig. 3. This maintains pressure on the wire as it wears its way downward.

It is evident from the above that open spaces at lower levels than the mass of slate to be cut must be provided for the guide-pulley standards. An open bench may be utilized. Fig. 2 shows the standards erected on platforms over the edge of an open bench. If no open bench is present an opening must be made, and this constituted one of the most difficult problems. A space about 3 ft. wide is necessary to accommodate the standard and the 26-in. guide pulley.

Originally a drum-drill was purchased in Belgium, as this was the type of equipment said to be used in Europe, where the wire saw has been employed for many years. This drill worked with fair success on vertical holes, but

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was not adapted to inclined holes. The teeth on the lower edge of the cutting drum were practically worn out in cutting two holes; therefore, it was abandoned and attention directed toward the design of a drill better adapted to the needs.

During 1927 the Ingersoll-Rand Company worked in close co-operation with the slate companies and developed a drum-drill which is now giving satisfactory service in at least three quarries. It cuts a 36-in. hole, using steel shot as an abrasive. The hole may be vertical or inclined at an angle. The sinking of inclined holes is a great advantage, for frequently the slate structures demand that inclined cuts be made. For example, the ribbon is commonly inclined at angles of 60 to 70 deg., and by paralleling the ribbon a greater proportion of the clear stock may be utilized. Obviously, the standards must be inclined at whatever angle it is desired to make the wire saw cut. Fig. 4 illustrates a standard erected in one of the 36-in. holes and a wire-saw cut in progress. Fig. 1 shows an inclined cut.

The estimated cost of sinking a hole in a soft-vein slate was $3.32 per foot and in the hard-vein (average of two holes) $4.90 per foot. These figures will no doubt be reduced when the method and the machine are more nearly perfected.

The wire saw cuts quite rapidly. In the early stages of the tests it was found that in making a cut 80 ft. long the wire would sink at the rate of a little more than 2 in. per hour, completing a cut 8 ft. deep in 45 hours, or five 9-hour days. A cut of this size would require about two weeks' time by the channeling-machine method.

The history of the development of any new type of equipment generally shows that early accomplishments are usually greatly surpassed as the equipment is perfected and greater familiarity with its operation is gained. This condition holds true for the wire saw. In cuts made up to the end of May, 1927, the average rate of cutting as measured by the surface obtained was 12.8 sq.ft. per hour. A report recently received of two cuts made simultaneously with a single wire gave a rate of 23.5 sq.ft. per hour, or nearly double the rate attained six months before.

The wire saw was first tried in the so-called soft-vein slate. Later both the core drill and the wire saw were used in the hard-vein, and, though cutting is somewhat slower than in the soft slate the operation is regarded as eminently successful.

On several occasions two cuts have been made successfully at the same time, using a single wire. In Fig. 2, two standards may be seen mounted on platforms. On passing from one cut the wire is carried to the second standard and from thence to a second parallel cut. One attendant can keep the wire in constant operation, even where two cuts are being made.

The wire wears remarkably little. A wire 800 ft. long on completing a cut 80 ft. long and 8 ft. deep—that is, after cutting a surface area of 640 sq.ft.—was found to be reduced in diameter less than $\frac{1}{32}$ in. It has been found, however, that a wire cannot be used until worn out. As the diameter is reduced even a small amount the groove between the strands becomes so small that it does not adequately carry the sand on which the cutting process depends, and the rate of cutting is greatly reduced. As the wire is low priced, costing less than 1c. a foot, it is evident that loss will result in attempting to use a wire for a second cut; it is more economical to begin every cut with a new wire.

A great advantage of the wire saw is the preservation of the slate by avoiding shattering. The channeling machine which is in common use strikes heavy blows, shattering and destroying the slate for 1 to 2 ft. on either side of the cut. Blasting, which is employed in some slate quarries, is even more destructive to the stone. The wire saw cuts by the simple process of abrasion and therefore has no shattering effect. It eliminates practically all of

SLATE

By OLIVER BOWLES

Mining Engineer, U. S. Bureau of Mines, Washington, D. C.

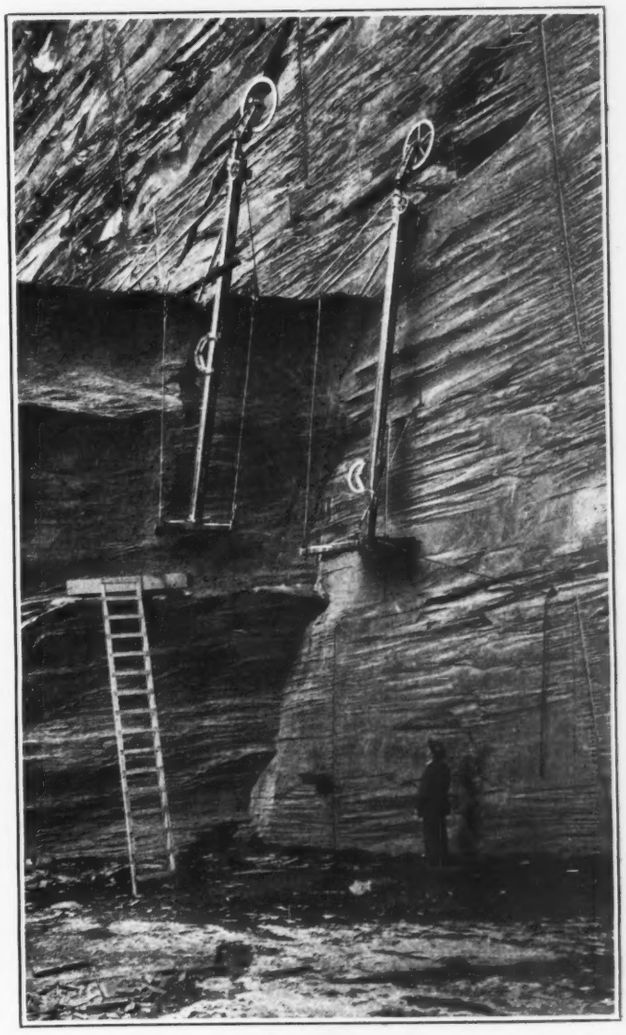


Fig. 2—Standards for wire cutter mounted on platforms over the edge of an open bench

the excessive waste directly attributable to the former methods, and thus has fulfilled the object of the tests.

Another great advantage is reduction in cost. The cost by the new method is one-quarter to one-half that involved in methods formerly employed, and the investment is also lower. The equipment is simple, and requires little supervision or power.

Slate operators in all districts have shown great interest in the saw, and it seems probable that it will soon be generally adopted. Interest is not confined to one industry, however. It is reasonable to assume that a saw which cuts slate will cut other types of rock. As its great advantages are in conserving material, in providing smooth surfaces, and in cutting without shattering, it appeals primarily to producers of dimension stone. In this age of competition producers of structural and ornamental stone are finding an increasing necessity for reducing production costs. Competitive materials of synthetic types, such as portland cement, brick and tile, and the various compounds of lime and gypsum, are finding wide use. Natural stone is of unsurpassed quality for many applications; nevertheless, to maintain its markets, prices must be kept within reasonable limits; and this can be done only by utilizing the most economical methods and equipment available. Therefore, progressive stone producers are considering the application of this new method to their particular quarries. Active interest has been manifested by producers of limestone, sandstone, marble, and granite. It has not yet been demonstrated that the wire saw will meet with the same

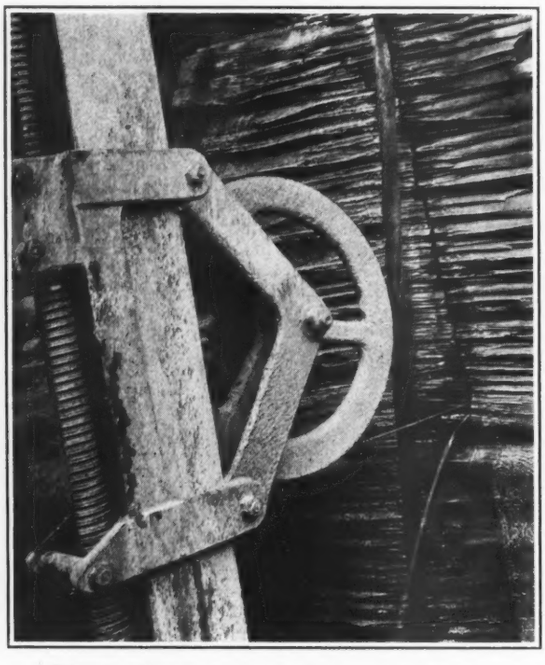


Fig. 3—Wire "saw" as it leaves the cut. Note the feed screw

success in other rocks as has been experienced in slate, but the wide interest now apparent and the active steps now being taken to test this new equipment point to the possibility of fundamental changes in quarry practice within the next few years.

The question may arise in the minds of mining engineers as to possible applications of the wire saw in other branches of mining. The cutting of smooth-walled drifts and haulageways and the closely allied processes of projecting subway, railroad, and water tunnels are possible fields of application that are at least worthy of consideration. A perfectly smooth, unshattered rock wall such as the wire saw provides might preclude the necessity for

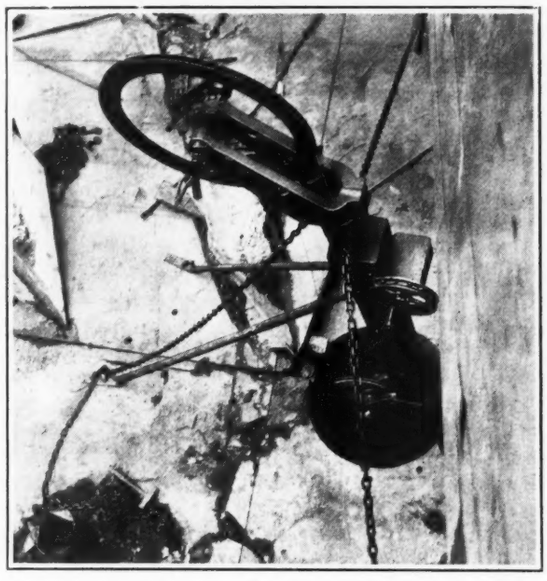


Fig. 4—Standard erected in a 36-in. core-drill hole with wire cutter in operation

concrete lining. It is difficult at this early stage to foresee the extent of wire-saw application, but the accumulated experience of operators in various types of rock will undoubtedly develop some interesting possibilities.

Reserves of Spanish Pyrite Large

THE accompanying table gives the reserves of pyrite in Spanish mines, as reported by Cesar Rubio and Joaquin Mendizabal in Vol. 2 of "Pyrite Reserves of the World," which has been published under the auspices of the Fourteenth International Geological Congress. The first of the two authors—namely, Mr. Rubio—was president of the congress.

Reserves of Pyrite in Spain

Mines	Actual Tons	Probable Tons	Possible Tons	Total Tons	Grade S, Per Cent
Concepcion	1,400,000	1,000,000	.....	2,400,000	43
San Platon	750,000	500,000	1,000,000	2,250,000	48 to 50
Esperanza	799,000	.....	.....	799,000	47 to 48
Cueva de la Mora	3,047,600	722,000	.....	3,769,600	44 to 45
Carpio	335,000	300,000	2,500,000	3,135,000	48 to 50
San Telmo	607,000	704,000	.....	1,311,000	45
Peña del Hierro	3,000,000	1,000,000	2,000,000	6,000,000	
Riotinto	151,306,050	70,000,000	.....	221,306,050	
La Zarza	35,000,000	12,000,000	8,000,000	55,000,000	
Perrunal y Lomero-Poyatos	6,000,000	2,000,000	4,000,000	12,000,000	47 to 50
La Joya	400,000	600,000	.....	1,000,000	47. 5
Castillo de Buitron	1,150,000	2,000,000	.....	3,150,000	43 to 49
Santa Rosa	400,000	100,000	.....	500,000	40 to 45
Romanera	200,000	800,000	1,000,000	2,000,000	
California-Concordia (Badajoz)	.....	400,000	600,000	1,000,000	
Sotiel-Coronada	1,080,000	580,000	.....	1,660,000	30 to 44
La Torerera	.....	1,500,000	.....	1,500,000	43, 5
Tharsis	56,500,000	42,500,000	33,750,000	132,750,000	
La Lapilla	500,000	1,500,000	1,500,000	3,500,000	
Herrerias	2,000,000	2,000,000	3,000,000	7,000,000	47 to 49
Cabezas del Parto	1,500,000	750,000	1,250,000	3,500,000	
Fronteriza-Vuelta Falsa	200,000	210,000	400,000	810,000	
Nuestra Señora del Carmen	40,000	100,000	500,000	640,000	
Castilla de las Guardas	3,500,000	5,000,000	2,000,000	10,500,000	40 to 42
Sililos y Cuchichon (Sevilla)	1,671,633	.....	3,500,000	5,171,633	42 to 47
Segunda Preciosa (Sevilla)	200,000	650,000	.....	850,000	38
Caridad (Sevilla)	1,144,512	645,838	.....	1,790,350	43
Totals	272,730,795	147,561,838	65,000,000	485,292,633	

Lime in Flotation

How to Use This Important Reagent Most Effectively

By S. E. Stein
Mining Engineer, Southwestern Engineering Corporation, New York

EXCEPT for a few purposes in which it plays a special part—as for instance in the selective reflotation of a bulk all-sulphide concentrate—lime as a flotation agent belongs to the class which includes such agents as caustic soda, trona, soda ash, and sulphuric acid. Each of these agents is used in company with a specific combination of oils and chemicals. The proper choice from among them can be determined only after a fair trial with the proper combination of accompanying reagents; and will be governed ultimately by the economic factor of net balance remaining after deducting total mill operating cost from total value of mill product. A diversity of factors may be involved, including not only total reagent cost, mineral recovery, and grade of concentrate, but also possibly the effect on the milling equipment and on the dewatering of concentrate.

Lime functions in the flotation process as calcium hydroxide, after being dissolved in the mill-circuit water. It is added as *(a)* burnt lime—calcium oxide with other substances residual after the burning of limestone, or *(b)* hydrated lime—dried calcium hydrate with other substances residual after the slaking of burnt lime, or *(c)* milk of lime—a suspension in water of particles of hydrated lime, or freshly slaked lime, making a mixture containing 25 per cent solids or less, depending on requirements. The water is, of course, saturated with respect to calcium hydroxide. Solubility of calcium oxide in distilled water, at 15 deg. C., is 0.120 per 100.

The effective portion of the added lime is that which goes into solution in the mill-circuit water to react as calcium hydroxide, and its magnitude will therefore be governed primarily by the quality of the original limestone and the efficiency of the burning. Lime should, of course, be purchased on the basis of the available calcium oxide of standard analysis, as this figure has a reasonably dependable relative value; but it is worth noting that the figure thus given will usually be higher than realized in practice, on account of the fact that solvent conditions in a mill circuit are not so good as those used by the chemist in his method for this analysis.

The choice between burnt lime, hydrated lime, and milk of lime will be governed by local factors. The problem to solve is that of getting the required quantity of calcium hydroxide into mill-circuit solution in the cheapest way consistent with accurate control of the feed. Feeding of burnt lime or hydrated lime requires a greater refinement of mechanical control than that ordinarily used for feeding ores, if the proper flotation control is to be attained. A storage bin or hopper delivering onto a feeder of the conveyor-belt type, the speed of which is controlled by a ratchet mechanism, variable cone pulley, or variable-speed motor, has been used successfully where the feed from bin to belt could be maintained uniformly with respect to range of sizes. Milk of lime offers a surer feed control, and for that reason has been adopted at plants where the highest order of metallurgical results are demanded. For feeding milk of lime a storage tank equipped with means for maintaining the calcium hydrate particles in suspension is required, as well as the variable-control fluid-feeder.

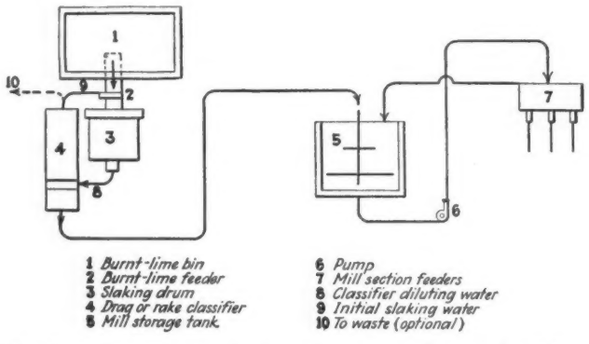
Unless the mining company quarries and burns its own limestone, as is done in several instances in Mexico, Central America, and doubtless other countries, it will have to decide between the purchase of burnt lime and hydrated lime. The adverse factor in burnt lime is the fire hazard wherever water shipment or long-time storage is required, or air-slaking in the latter case. Also, it is worth mention at this point that it is the opinion of some operators that the introduction of burnt lime directly into a low-temperature mill-circuit such as obtains during winter months in mills located in cold countries requires longer time for slaking and dissolving, and consequently results in unnecessarily high lime consumption. However, this would not operate against the choice of purchasing burnt lime in preference to hydrated lime, if the company could find it advantageous to slake the lime previous to its addition, and feed it as fresh milk of lime. In most cases the payment of higher prices for hydrated lime will be found unwarranted, as a fairly good grade of burnt lime is usually available at the same source, from which a unit quantity of calcium hydroxide can be furnished to the mill circuit more cheaply than can be so furnished by the hydrated lime.

The accompanying flow diagram shows a continuous lime-slaking and milk-of-lime feeding plant which can be utilized in laying out an installation for any required scale of operation. In most cases the lime is added at the head of the fine-grinding circuit, thus giving usually a treatment of 12-min. duration. This is certainly ample when feeding milk of lime, and possibly sufficient when adding burnt lime direct.

A few years ago some operators added an arbitrary quantity of lime directly to the ore, chiefly with the purpose of preventing corrosion of the steel milling equipment which otherwise would result on account of the acid nature of the ore. No attempt was made to insure the presence of a residual caustic alkalinity in the flotation head water. Today, as far as I am aware, every operator of a flotation plant using lime in the primary milling circuit uses a frequent periodical test of the flotation heading water made to insure the presence of caustic alkalinity. In many small plants the alkalinity is considered satisfactory when one or two drops of phenolphthalein colors 100 c.c. of the decanted water a faint but definite pink. Most of the larger plants, how-

ever, have found that it pays to maintain a definite caustic alkaline strength, which is ascertained by titration with standard acid.

A characteristic procedure is the titration of a 100-c.c. sample of flotation heading water with sulphuric acid solution wherein 1 c.c. contains 0.005 grams of acid. If, for example, the mark set for the operator is 1 c.c. of standard acid, using phenolphthalein as indicator, the indicated approximate hydroxyl-ion concentration is



Typical flow sheet of plant for preparing and adding lime to mill circuit

equivalent to 0.0575 lb. calcium oxide per ton water, or 0.23 lb. calcium oxide per ton ore, at 20 per cent solids. It should be noted that the original addition of burnt lime necessary to obtain this residual alkalinity at the point of flotation may have been any quantity from 1 to 7 lb. lime per ton ore, depending on the quality of the lime and the nature of the ore and the character of the mill water.

With regard to the comparative deleterious effects of "underliming" and "overliming," a more thorough investigation as well as the collection of available data from diverse sources is needed. For what it may be worth, I am herewith setting forth my present impression on this subject. It is probable that the theoretically best degree of alkalinity varies for each mine, and consequently also varies with ores originating at different points in the same mine. The necessity of constant experiment is indicated.

In starting operation with lime it would be wise to set the standard point of alkalinity sufficiently far in advance of neutrality—consistent with the avoidance of excessive overliming—to reduce the recurrence of complete loss of alkalinity to a minimum. "Underliming," especially when it results in complete loss of alkalinity, is markedly harmful to metallurgical results. The froth livens up, becoming decreasingly selective in appearance as the alkalinity diminishes. If the condition is not remedied by speedy lime additions, the froth will "run away" in spite of attempts at correction by reducing the quantity of the frothing agent. This naturally affects both the concentrate and the tailing.

"Overliming" has the reverse tendency unless carried excessively far, when a condition in outward appearance something similar to "underliming" will take place. The first "overliming" slows the froth down slightly, and thus has a tendency to clean up the concentrate with slight loss in the tailing. This moderate "overliming," however, is not usually harmful, as it is easily corrected. The corresponding degree of "underliming" usually would show a definite loss in tailing for the shift. However, at one plant which treats a variable ore, I have noted on three separate occasions the loss of a considerable quantity of the standard alkalinity, without a manifestation of the bad "underliming" effects as described.

One plant treating a fairly clean sulphide ore, as indicated by its low burnt-lime consumption of 1.5 lb. per ton of ore, used a standard of alkalinity for the flotation heading water equivalent to 0.20 lb. calcium oxide per ton ore (at 20 per cent solids). Markedly bad effects were noted when this quantity fell below 0.10 lb. CaO, but the facts are uncertain as to the intermediate range. Samples were taken at half-hour intervals.

Another plant, having a lime consumption of approximately 5 lb. per ton of ore, used a standard equivalent to 0.10 lb. CaO per ton of ore, at 20 per cent solids. Titrations were made at 15-min. intervals. The bad effects were visible to the operator when the alkalinity declined to 0.07 lb. CaO, and the appearance of a couple of "0.05's," and say, one "0.00," on the titration record sheet was an infallible sign that the corresponding assay sheet would indicate inferior metallurgical results. The effects of "overliming" certainly were not visible to the operator until an alkalinity of 0.15 to 0.17 lb. CaO was reached, and inferior metallurgy resulted with certainty only when a considerably higher figure was reached.

Further research is required to guide the operator in this matter. Hydrogen-ion concentration measurement, together with an investigation of the part played by the calcium ion, holds great possibilities.

Among the various ores treated at one company's plant there would occasionally be received one which laboratory tests indicated was amenable to flotation treatment, with approximately equal results, by the use of either lime, or sulphuric acid, or in a "neutral" circuit. But the rule was that either alkaline or acid circuit, each with its special accompanying reagents, was required to produce the best obtainable metallurgy. The "neutral" circuit would show material losses in the tailing. There is, of course, the possibility of existence of a suitable reagent for the "neutral" circuit, but this was not discovered.

As little is known about the reactions by which lime accomplishes its purpose as about the other obscure physico-chemical phenomena of flotation. The cause of the obscurity becomes apparent, however, when consideration is given to the numerous elements commonly present, a majority of which undoubtedly interact to some degree with the lime. It remains for future research to determine finally which of these elements consumes lime without contributing to the desired flotation effect, and which are affected by the lime in some manner beneficial (in the strictest sense) to the flotation operation. These elements may be listed as follows: (*a*) dissolved salts, colloids, and certain suspended matter, in the initial mill water; (*b*) the ore itself, with its content of salts soluble in the circuit water; colloids, or other finely divided substances such as complex hydrous oxides of iron, aluminum and silicon; certain superficially affected minerals; part of the valuable mineral in perhaps a colloidal state—for example, sooty chalcocite, (*c*) carbon dioxide contained in the entrained air, (*d*) the accompanying flotation reagents, and (*e*) the air-liquid-solid interfaces.

At one plant I made an investigation to determine the cause of high lime consumption, with some interesting results. The plant in question slaked purchased burnt lime, and fed it into the mill at the fine-grinding section as milk of lime. Materials used in the investigation were standard sulphuric acid, phenolphthalein, storage-

tank milk of lime, distilled water, initial mill water, filtered mill-pulp water, chemical analysis of filtered "neutral"-pulp water, filtered pulp water obtained by washing dry ground ore with distilled water, and sundry wet-pulp samples taken at various points throughout the mill. The titrating method involves inaccuracies; but as the error probably was uniform throughout the tests, the relative values obtained are valid for the purpose. Some of the conclusions are set forth in the following:

1—The accompanying tabulation shows the approximate distribution of the lime consumed:

	Per Cent of Total Circuit Water-Soluble CaO Consumed	Per Cent Original Burnt Lime
Original added burnt lime, having an available CaO by stand ardanalysis of 80 per cent, and mill-available CaO of 65 per cent	....	100.00
Consumed by unknown solids or colloids in the ore	(*a*)77.00	50.05
Consumed by salts dissolved from the ore	2.31	1.50
Consumed by interaction and precipitation with salts of the initial mill water	20.69	13.45
Available CaO (by standard analysis) passing out with tailing as undissolved solids	....	15.00
Carbonate, siliceous material, and other waste in the burnt lime	....	20.00
Lime consuming salts in initial mill water and ore, mutually eliminated by interaction, equivalent to	18.18	....

(*a*) It should be noted that the equivalent quantity of hydroxyl ion was consumed by these substances, irrespective of whether this was through adsorption, or on account of the substances having become soluble and immediately reprecipitated in the alkaline medium.

2—The hydroxyl-ion concentration of the flotation heading water was equivalent to 0.10 lb. CaO per ton ore at 20 per cent solids. Consumption during the 9 min. of rougher flotation, due perhaps chiefly to the carbon dioxide content of the air, was small, not over 0.07 lb. calcium oxide per ton ore, part of which was replaced by solution of theretofore undissolved lime particles. This low loss is perhaps due to the low hydroxyl concentration.

3—The reactive content of the lime reacts quite rapidly, approximately 90 per cent of it in less than 5 min. That portion dissolved during the 9 min. of rougher flotation was very small, approximately 0.04 lb. calcium oxide per ton ore. Some idea of the character of the undissolved calcium oxide passing out with the tailing was obtained by washing the filtered tailing solids a number of times with distilled water. Three washings over a period of one hour dissolved a quantity equivalent to 0.10 lb. per ton of ore; after standing for 25 hours the water had a content equivalent to 0.23 lb. CaO per ton ore, and after 48 hours a content of 0.30 lb. CaO.

4—Flotation heading water, like distilled water, dissolved, without further consumption, further additions of lime. Initial mill water contains a finely dispersed solid, part of which is practically a true suspension. Small additions of lime to this water react to form a small-grained, slow-settling precipitate. Further additions of lime, say a quantity equal to its caustic-lime consuming capacity—that is, about 1.5 lb. calcium oxide per four tons of water—produced a partial flocculation of this precipitate. As the quantity of lime added was still further increased, more of the precipitate was flocculated and made quick-settling, the maximum flocculating and settling condition being achieved with the addition of a quantity of calcium oxide approximately equal to that used under mill operating conditions.

5—Laboratory-scale tests were made to determine whether any difference in lime consumption could be obtained by varying the point of addition of the lime. In one set of tests ground crude ore, initial mill water, and milk of lime were combined in various ways; and in another set a primary-mill pulp product, additional initial mill water, and milk of lime were similarly combined. The two sets of tests checked each other and revealed the same facts. Given a particular ore, a particular milk of lime, and a required 20 per cent solid, no variation in lime consumption could be obtained, by adding all the lime to a 33 per cent solid pulp before diluting to 20 per cent solids on the one hand, and adding it all to the water before pulping with the ore on the other; nor by adding all the lime only after the 20 per cent solid pulp is formed.

In conclusion I should like to suggest the field in which further investigation of the subject should be directed. It is necessary to know a great deal more about the action and effects of the calcium ion; and this may prove a difficult problem. With respect to the hydroxyl ion it is probable that experimentation with various reagents used in flotation under careful pH control[2] will result ultimately in important advances in our knowledge. One large mining company that found it profitable to adopt pH control as a guide to flotation operations discovered that the correct value when using one reagent was not the best value when using another. Thus, when it discontinued the use of a lime-xanthate circuit in which the correct pH value was approximately 10, it was found that the lime-aërofloat circuit, subsequently introduced, operated to best advantage when the pH was 8.3.

Sulphur in Construction

ALTHOUGH sulphur is one of the cheapest raw materials, its use has, until recently, been almost wholly confined to that of a chemical reagent, as in the manufacture of sulphuric acid, sulphite wood pulp, and vulcanized rubber, according to the *Industrial Bulletin* of Arthur D. Little, Inc. It has, however, lately been applied to the impregnation of paper board, upon which it confers great rigidity and strength, while cotton fabrics similarly treated have been successfully tested for the protection of pipe lines from corrosive agencies.

Sulphur itself in its usual elemental form lacks strength and is easily broken down. When, however, it is properly supported in a porous vehicle, as paper board or portland cement, it not only adds greatly to the strength of the carrier, but enables the combined structure to resist the action of many destructive chemicals. Concrete containing 15 per cent of cement has shown, when impregnated with sulphur, ten times the tensile strength of plain specimens.

Wood may be impregnated with sulphur by methods similar to those in use for timber preservation, and as sulphur melts at a temperature a little above the boiling point of water to a mobile liquid, there is little difficulty in securing effective penetration. Wood thus treated should prove useful in the construction of pickling tubs for the metal industries and for tanks in chemical works.

Large electrolytic cells made of concrete impregnated with molten sulphur have been in use for two years.

[2]This is Sörensen's symbol for the negative logarithm of the hydrogen-ion concentration.

Photographs from the Air

Left—Birch Lake mining district of Ontario, showing where overburden has been stripped for prospecting

Below—An aërial view of the Copper Cliff smelter of the International Nickel Company

In the left center is the town and athletic field; in the left foreground the blast-furnace slag pile; at the center the blast-furnace and converter departments and shops; to the right the reacting and reverberatory departments and reverberatory slag pile. Close to the horizon line is seen Whitewater Lake, five miles away, beyond which the newly developed Errington mine of the Treadwell-Yukon Company is situated.

Aerial Surveying in Canada

By F. H. Peters
Surveyor General, Topographic Survey of Canada, Ottawa

CANADA is finding that her pulpwood areas are an asset of magnitude, that her water-power resources are capable of immense development, and that her mineral possibilities are very great indeed. Nearly all the country into which these new industries are penetrating has been unmapped from a topographical point of view and much of it has been practically unexplored, so that the necessity for maps of these regions is therefore urgent. To meet this urgency the Topographical Survey of the Canadian Department of the Interior is paying a great deal of attention to these districts in carrying on its mapping program. In this program it is intended eventually to cover the whole country by the various map sheets of the National Topographic Map of Canada, which sheets are designed to fit into a regular series and are issued on the scales of one, two, four, and eight miles to the inch.

The topography of the country, with its many lakes and rivers, makes it readily adaptable to mapping by the use of aërial photography, combined with a sufficient amount of ground control. By this means the work is expedited greatly and territory is covered in a short time which would otherwise take a tremendous amount of time and effort to cover by the regular ground methods.

In the aërial surveys work for 1927, a total of 45,850 square miles was photographed—28,650 square miles by oblique and 17,200 square miles by vertical photography —the work extending into eight of the nine provinces. The greater part of this territory lies within the Pre-Cambrian shield, where such a large proportion of Canada's mineral wealth is contained. The mapping work that is being carried on within these districts will, accordingly, be of immense help in mineral exploration.

Whatever may be the immediate necessity in the production of any of these topographic map sheets, their basic nature makes them of value in a variety of ways so far as opening up the country is concerned. Their value, for instance, to the prospector can hardly be estimated when he is endeavoring to find his way through a tortuous maze of waterways, large and small, that is characteristic of the Pre-Cambrian shield.

Some of the work done which may be said to relate most definitely to the mineral industry is the covering by oblique photography of nearly a thousand square miles in Saskatchewan, adjacent to the Flin Flon district; vertical photography over about 645 square miles in the neighborhood of Sudbury for basic mapping on behalf of the Geological Survey of Canada; and vertical photography for a similar purpose over 440 square miles near Saint John, New Brunswick.

All the field operations are only preliminary to the issue of the map sheets to the public. The preparation of the map sheets is undertaken at once upon the completion of the field work. During the 1927 season, a number of new map sheets were issued based upon the work of the previous year, many of which covered portions of the Pre-Cambrian shield. One of the sheets that was of particular interest to the mining profession was the two-mile Rouyn-Larder Lake sheet, embracing an area extending into the provinces of Ontario and Quebec in the vicinity of the new Rouyn field. Another was the four-mile Cormorant Lake sheet, which takes in the location of the Flin Flon mine, in northern Manitoba. Further sheets of interest to be issued soon are: Rouyn Lake two-mile sheet lying immediately east of the Rouyn-Larder Lake sheet; Kississing Lake four-mile sheet lying immediately north of the Cormorant Lake sheet and including the Sherritt-Gordon property; a number in northwestern Ontario; and others.

Origin of Supplies Used by Rand Mines

A LARGE part of the supplies used by the mines of the Rand is purchased locally. The following tabulation, taken from a brochure entitled "The Gold of the Rand," issued by the Transvaal Chamber of Commerce, shows the quantities of South African and imported supplies purchased by the producing mines of the Witwatersrand during the last 23 years. It will be observed from this that the proportion of the total that is of South African origin has shown a steady increase.

Supplies Consumed by Witwatersrand Gold Mines

Year	South African Origin	Imported	Total
1904–5	£2,220,687	£4,352,150	£6,572,837
1905–6	2,676,301	5,450,244	8,126,545
1906–7	3,009,261	4,455,209	7,464,470
1907–8	3,305,097	4,251,770	7,556,867
1908–9	3,881,359	5,038,846	8,920,205
1909–10	4,416,195	6,162,262	10,578,457
1910 (July-Dec.)	2,411,570	3,430,050	5,841,620
1911	4,872,916	6,343,540	11,216,456
1912	4,752,044	5,001,707	9,753,751
1913	5,557,683	4,571,117	10,128,800
1914	5,335,689	4,472,791	9,808,480
1915	6,023,339	4,411,624	10,434,963
1916	6,502,567	5,285,030	11,787,597
1917	6,896,210	5,292,918	12,189,128
1918	7,398,243	5,171,663	12,569,906
1919	7,592,157	5,148,017	12,740,174
1920	8,239,373	5,575,286	13,814,659
1921	8,264,646	5,675,542	13,940,188
1922	6,631,851	4,006,500	10,638,351
1923	8,197,083	4,688,942	12,886,025
1924	8,317,162	4,933,023	13,250,185
1925	8,339,946	4,874,874	13,214,820
1926	8,599,595	4,781,814	13,381,409

Some of the purchases by Witwatersrand mines during 1926 were as follows:

Candles	£145,298
Castings (iron)	181,338
Cement	165,109
Chemicals, assay, and smelting	139,456
Coal and coke	970,861
Cyanide	285,478
Electrical machinery and spares	592,808
Explosives	1,770,495
Meal (mealies, kaffir corn)	369,713
Meat	329,966
Sundry food, including bread	175,220
Hand tools (picks, shovels)	99,750
Lime (white)	149,809
Machinery and machinery tools	332,179
Machine spares other than electrical	348,193
Pipes and fittings	435,190
Rails, crossings, sleepers	293,910
Rockdrill spares	446,330
Ropes (wire)	196,806
Shoes and dies	101,665
Steel (rock drill)	293,830
Mining poles and lagging	582,427
Trucks and spares	129,120
Zinc and zinc disks	101,917

Disk Crushers—
Their Development and Advantages

CONCLUDING INSTALLMENT

By W. T. W. MILLER

Engineer in Charge, Crushing Machinery Department, Hadfields, Limited, Sheffield, England

AS PREVIOUSLY STATED,* the horizontal type of disk crusher with the ball wedge in place of the inner shaft does not appear to have progressed far beyond the experimental stage, but it is interesting as the forerunner of the second series of disk crushers with axis vertical and disks horizontal. This vertical disk crusher, illustrated in Fig. 5, was originally intended as a large-capacity unit for finer reduction than was possible with the lever type machine. The upper disk was dished to give the tapering cavity, and the lower or floating disk was made flat. The crushing surface of the upper disk was also flattened at the periphery for a radial distance of about 4½ in. on an outside diameter of 48 in. This construction made the exit opening approximately parallel for the width indicated, so that, should a piece of ore be broken near the outer circumference of the cup, it would have to travel outward for a distance of at least 5 in. (since the path of the material is tangential, the actual distance is greater than the radial dimension), and before it could escape from the disks these would close again and subject the particle to another crushing stroke.

In the horizontal disk crusher the maximum size of the finished product is determined by the greatest opening between the faces at the end of the withdrawing stroke, but in the vertical crusher, and by reason of the construction described above, the maximum size of the product was regulated by the minimum aperture between the disks, and it was therefore possible to obtain a finer product without setting the disks too close to each other.

If the faces are brought close together at the end of the crushing stroke in any form of reciprocating breaker, the packing of the material into a thin film, without sufficient room for it to spread sideways under the pressure, causes excessive strains on the bearings and structure of the machine. It is therefore evident that the new method of sizing the finished product possesses great advantages over the older system, particularly when reducing to less than half-inch material.

The spider or carrier plate, to which the upper disk was secured by means of a split ring and clamping nut, was made in two parts, the main casting being threaded to screw inside an outer ring so that the disk and disk plate could be adjusted vertically without disturbing the ring which rested on distance ferrules separating the upper part of the machine from the bedplate for the lower disk.

A circular casting with an internal flange was fitted above the outer ring and heavy springs were introduced between the top of the ring and the inside of the flange. The clamping bolts securing the top plate to the flange on the lower drum passed freely through the screwed ring, springs, and distance pieces with nuts bearing on the upper flange of the cover plate. By tightening these bolts the spider ring was forced to its bed on the ferrules and the springs were compressed to such an extent as to resist effectively any normal crushing pressure while remaining sufficiently resilient to form a safety device against excessive overstrain due to packing or other cause. This spring cushion was one of the outstanding features of the new machine as compared with the rigid crushing members in the older crushers. The mechanism for applying the crushing force was generally similar to that in the machine shown in Fig. 4, except that long shafts were not required and bevel gears were used to distribute the driving force from a single pulley and countershaft. The stationary bedplate consisted of a circular basin with a cylindrical well having a shallow inner ring with a flange round the greater part of the circumference, to which was bolted the base of the fixed chimney or center stem of the machine. The continuity

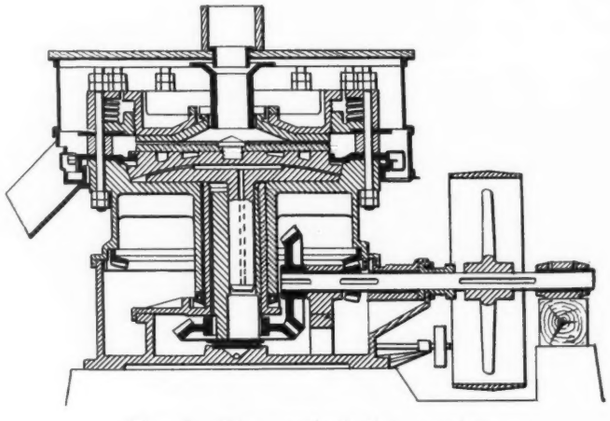


Fig. 5—The vertical disk crusher

of the flanges was broken to leave a space for the inner bevel pinion, and two of the three bearings for the countershaft were built into this lower frame.

The superstructure carrying the upper disk and spring cushion was bolted to the outer flange of the rotating table supporting the ball wedge and lower disk. This table was made with a long tubular boss with a babbitted

*Part I appeared in last week's issue. Copyright is reserved by the author.

lining forming a bearing outside the center stem rising from the baseplate of the crusher. The whole weight of the revolving parts was supported by thrust rings with ball bearings placed between the lower end of the boss and the base of the chimney piece.

To exclude dust from the internal parts an outer curtain ring was cast on the rotary table and the lower edge of this ring was grooved to pass freely over the circular wall on the stationary baseplate, allowing sufficient clearance space for free rotation of the head. The bevel-gear ring for transmitting the motion from the countershaft to the table was riveted inside the lower edge of the rim, and this wheel was driven by a bevel pinion of small diameter fixed in an intermediate position on the countershaft.

A shallow circular recess of large diameter with part-spherical side walls was cut in the top of the table, and the underside of the mushroom-headed wedge was supported on the flat surface formed in the bottom of this recess. Above the "nail" head of the wedge was laid loosely the inverted saucer casting to which the lower disk was attached by setscrew and washer plate. This

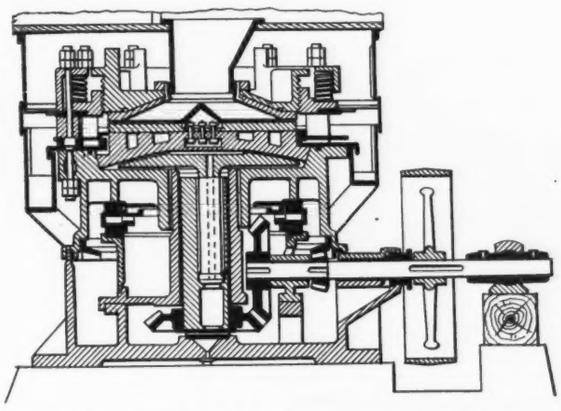


Fig. 6—In this later type of disk crusher an improved means of supporting the revolving mass was used

anvil plate for the flat disk was made with an enlarged foot ring, which was covered by a large washer extending outward beyond the flange on the revolving table and held down by the distance pieces or ferrules used for protecting the tiebolts from wear.

The stalk or driving pin of the mushroom projected downward in the bore of the eccentric, which was journaled in a babbitted bearing formed inside the chimney. This eccentric was supported on thrust washers resting on a boss in the center of the bedplate and a bevel wheel keyed to the lower part of the eccentric geared with the larger bevel pinion on the countershaft. The side displacement of the spherical head of the wedge caused the anvil-plate for the lower disk to lie at an angle to the horizontal, and the rotary eccentric motion imparted a circular undulatory movement to the disk which was free from any turning effort. Crushing movements were therefore identical with those in the horizontal crusher. The disks revolved together in the same direction and at the same speed.

Surrounding the upper part of the machine was a sheet-steel housing with a circular receiving channel for the crushed product. The washer plate covering the upper surface of the rotary table was extended over this channel. A series of paddles was attached to the plate to propel the fine material around the track to the outlet chute, which was placed in any suitable position.

A comparison of the mechanism with that illustrated in Fig. 4 shows that the essential features were similar, but the later machine was more compact and the single

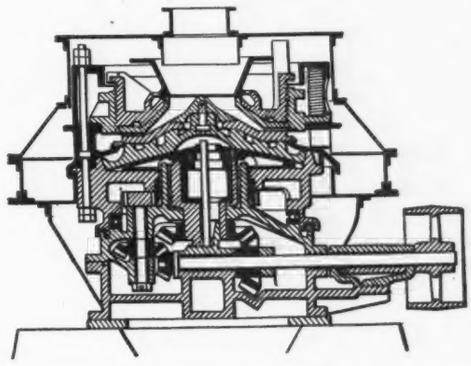


Fig. 7—A 36-in. vertical disk crusher. The lower disk was made conical instead of flat

belt drive simpler for installation purposes. The mass of the lower disk and anvil plate above the mushroom wedge was sufficient to insure reasonable contact between the bearing surfaces.

The vertical disk crusher proved to be a very useful machine, but, as was to be expected, continuous operation under strenuous conditions led the way to certain improvements in design. Fig. 6 shows some of the changes made. It was found in practice that the method of supporting the revolving mass comprising the table, the springs and cushion plates, and the disks, was inadequate, and a track ring was fitted underneath the rotary table to carry the weight, the track resting on a series of rollers attached to a cage. The lower roller-path was supported on a cylindrical extension rising from the crusher base.

The system originally adopted for collecting the crushed product at a single outlet by means of scrapers working in a circular channel caused heavy wear on the paddles and linings. Sloping chutes were introduced with outlets at two opposite points, so that discharge could be effected by gravity. Intermediate collars were formed on the main tiebolts, so that the spring pressure could be retained between the cushion plates when necessity arose for dismembering the superstructure. Locking devices to prevent accidental turning of the screwed spider plate carrying the upper disk were introduced with beneficial results.

For a number of years the vertical disk crusher was made in one size only, with disks 48 in. in diameter. To provide the parallel crushing surfaces and allow a safe working angle between the conical interior and the flat disk, with an inlet opening of adequate diameter, occupied so much area that a smaller diameter was not considered likely to give a serviceable crusher.

A few machines were ultimately made with disks 36 in. in diameter, and one of these was illustrated in an article by David Cole in *Engineering and Mining Journal*, from which Fig. 7 has been prepared. The lower disk was made conical instead of flat as formerly; the floating wedge was a casting of bronze or gun metal, as compared with the steel mushroom incased in babbitt metal as in Fig. 6; the eccentric bearings were much shorter than

in previous designs; and the driving gear was modified by the introduction of a third pair of gears.

The most important change had reference to the means for supporting the rotary table. In this machine the rollers and tracks were abandoned in favor of balls in hardened-steel races. Although this particular size and pattern may have proved acceptable for the purpose for which it was designed, it does not appear to have been adopted as a standard.

Messrs. Symons Brothers have recently further improved their 48-in. vertical machines, as shown in Fig. 8, by substituting a ball race of special design for the somewhat complicated roller cage. The balls are confined in a perforated plate and are arranged in three rows, which are not concentric but follow spiral lines, so that the paths of the balls sweep over a wide area and the tracks take the form of flat surfaces without grooves. The babbitted faces on the mushroom head, which were changed to bronze in some of the later machines, have now been omitted. The solid steel head is made to gyrate between two machined cast-iron surfaces. Also the shape of the base plate has been changed, and the connection between the chimney and the frame has been modified so that the attachment bolts are accessible from the outside.

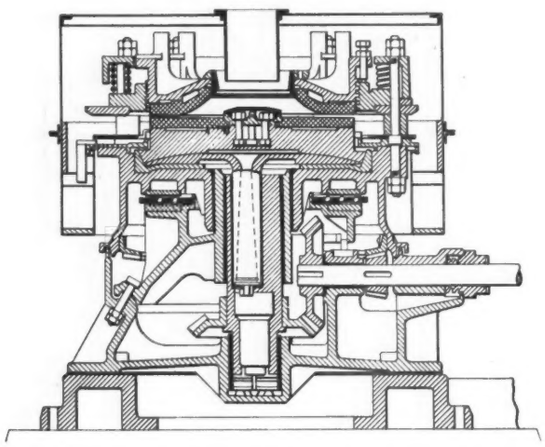


Fig. 8—A 48-in. vertical disk crusher in which a ball race has been substituted for the roller cage as a means of supporting the rotary table

The 48-in. vertical disk crusher can be fitted with disks of suitable shape for either medium or fine crushing. With the former the feed should not exceed 6 in., and the finished product would be about 1 in. When arranged for fine crushing the feed should be approximately $2\frac{1}{2}$ in., and the product, on a free-breaking material, will average $\frac{3}{8}$-in. cube.

The vertical disk crusher possesses certain advantages over the horizontal machine: the material is spread more evenly over the surfaces of the disks; the springs permit of the disks being set closer together without packing; and the parallel crushing faces insure a finer product.

Against these advantages must be set the following disadvantages: the rolling wedge, rollers, eccentric, and gears are difficult of access, so that repairs cannot be made with the same ease as in the horizontal crusher; and the lubrication system is also more complicated and more likely to be clogged with float babbitt and dust

Disk crushers as a class are very susceptible to damage by tramp metal in the feed. In this respect they are inferior to spring rolls. It is not so much that an important part of the crusher may be broken by the abnormal strains. This may happen if the trouble recurs at frequent intervals; but the presence of the unbreakable material between the disks quickly destroys the eccentric bearings and, in the vertical machine, causes damage to the internal gears.

Vertical disk crushers are protected to some extent by heavy spiral springs above the upper disk, and Fig. 9 shows a similar contrivance applied to the horizontal crusher. This is not a standard fitting for the latter crusher.

The Disk Crusher Versus Rolls

The chief merit of the disk crusher as compared with rolls lies in the fact that for the whole of their life the disks remain practically smooth without any tendency to form corrugations, and the uniformity of the product is maintained throughout. As a matter of fact, the regularity of the sample is usually better from worn faces than it is when the disks are new, which is certainly not the condition encountered with rolls when crushing hard ore.

In the smaller sizes there is some tendency for the wear to be concentrated near the rim of the disk, with the result that the movement forward to compensate for the lost metal restricts the aperture at the feed point. This can be overcome by using one new disk with one that is half worn out or by altering the shape of the disks.

A similar difficulty arises in some instances with the lower disk in the vertical crusher when a ridge is formed by wear opposite to the intersection line of the conical and flat surfaces on the upper disk. This difficulty can be surmounted, however, by changing the contour of the disk.

Large disk crushers will take a bigger feed than rolls of moderate diameter, and the wedge action is so effective that hard, rounded boulders are gripped and crushed with ease.

Disk crushers are particularly serviceable for the intermediate processes in plants of moderate capacity. The number of sizes in the horizontal machines is adequate to cover a wide range of outputs. Within the limits specified, the size of the finished product can be adjusted readily and maintained until the disks are worn out. With reasonable precautions against metal in the feed the cost of upkeep is very low, and their output per horsepower will compare favorably with any other secondary breaker.

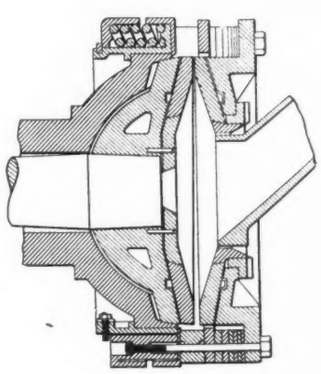


Fig. 9—Springs are used in this horizontal crusher as protection against tramp iron and other unbreakable material

Silver-Lead-Zinc Veins at Atlin, B. C.

By HUGH E. MCKINSTRY
Mining Geologist, Cambridge, Mass.

ATLIN, in the northernmost corner of British Columbia, was well known in the days following the Yukon gold rush, when placer miners thrived on Pine Creek and Cedar Creek. The locality was later famed in mining circles because of the checkered career of the Engineer mine. Ores of a type entirely different from those of the Engineer, and in the opposite direction from the town of Atlin, have recently been under development by J. M. Ruffner, who came to the district during the early placer boom and for the last five years has been developing the veins on Vaughan Mountain, 14 miles west of the town.

The district is reached by a rather devious route from Skagway, Alaska, over the White Pass Railway to Carcross, Yukon Territory, thence over lakes by boat in summer and on the ice in winter to Atlin village, from which a wagon road through jack-pine forest leads up Fourth-of-July Creek to the properties on Vaughan Mountain.

A number of features lend geologic interest to the deposit: the localization of the veins by basic dikes, the relative rarity of pyrite among the sulphides, and the broad range of temperature represented by the minerals present, for the sequence begins with pyrrhotite, ordinarily characteristic of the deeper zones, passing through the tetrahedrite of milder temperature to ruby silver. In fact, the latest fracture filling consists of veinlets of ice, which, in the underground workings, might be mistaken for gypsum or calcite until one applies the infallible fusion test by warming the mineral with a lamp flame. Though the ore carries a significant amount of gold, the chief value is in silver, lead, and zinc.

OXIDIZED ORE REMOVED BY GLACIATION

Low, rounded mountains rise from the broad valley in which lie Atlin Lake and Fourth-of-July Creek. This plain, which stretches to the snow-capped peaks beyond Tagish Arm, is dammed in places by moraines and eskers from recent glaciation. Above the débris that lies on the lower slopes of the hills, glacial cover, if it was ever deposited, has been removed. Vaughan Mountain has been planed and rounded by glaciation of an earlier period. As a result, the oxidized portion of the veins has been removed and fragments of fresh galena are often found in the soil at a depth of only a few feet; and stringers of solid sulphide have been opened up in cuts not more than 10 ft. deep.

However, the outcrops are not well exposed. The slope of Vaughan Mountain, except for a few protruding knobs, is covered by rather deep soil and with a muskeg-like growth of moss or scrub brush, or else is strewn with loose, angular granite blocks. Prospecting is aided by the fact that superficial rock fragments are usually near their point of origin, and the veins may—not without some difficulty—be traced along the hillside by float consisting of yellowish or iron-stained quartz among the granite blocks. Dikes, particularly where mineralized, have undergone more rapid weathering than the granite which they intrude, so that the trend of each dike is marked by a line of gentle depression.

In places, strong oxidation extends below the surface for 50 ft. or more, but beyond that depth it is almost negligible.

VEINS OCCUR ALONG DIKES

The ore deposits have been described as "mineralized dikes,"[1] and though this characterization is, in a sense, correct, it may be a little misleading. Although the ore occurs in and along dikes, the veins themselves are well-defined fissures, bordered in places by some replacement both of the dike rock and of the granite. They sometimes cut through the interior of the dikes, but show a preference for the dike walls or for the margins of slab-like inclusions of granite.

Vaughan Mountain is a part of an intrusion of granite which resembles petrographically that of the Jurassic Coast Range batholith. It is probably a stock satellitic to the main batholith which appears 25 miles to the east, near the Engineer mine.

The granite is coarse grained and light gray in color, consisting of quartz, feldspar, biotite, and hornblende. Locally, hornblende becomes the predominant dark mineral, and in such places quartz is less abundant or nearly absent, so that the rock approaches a hornblende diorite. The main mass of the rock, however, is a true granite or a quartz monzonite.

A typical specimen, examined microscopically, showed the feldspars to be oligoclase and microcline. The oligoclase forms automorphic crystals, showing albite twinning, and tends to be surrounded by the microcline. Quartz shows an inclination to fill the interstices between the feldspar crystals. Hornblende is of the common variety and biotite is subordinate to it in amount. Titanite and biotite are accessory minerals.

The granite carries pegmatite and aplite veins, which appear to be later phases of segregation from the granite magma and have no direct relation to the ore deposits.

At least six through-going dikes ranging up to 20 ft. or more in width cut the granite. They all have a

[1] Cairnes, D. D.: "Portions of the Atlin District, B. C.," Mem. 37, Can. Geol. Surv. 1913, p. 109.
See also Clothier: Report of the Minister of Mines, B. C., 1921.

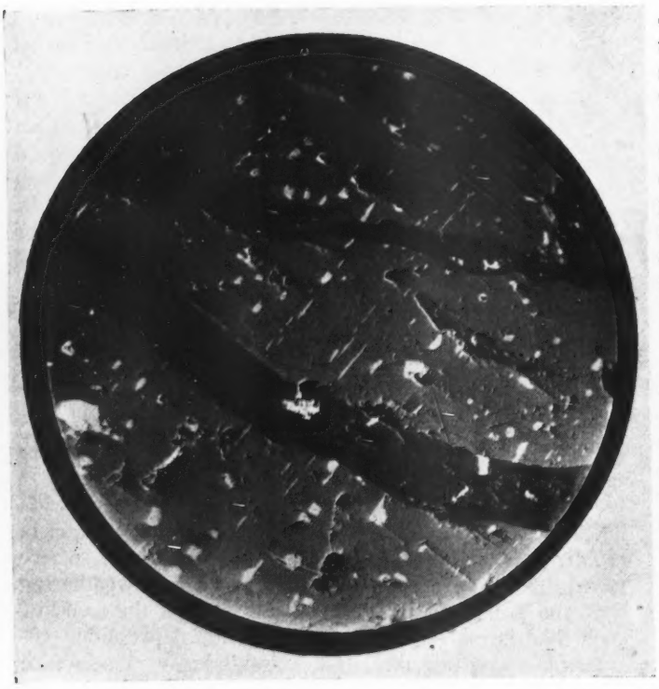


Fig. 1—Chalcopyrite inclusions in sphalerite, showing tendency to elongation and arrangement in lines. Etching of the sphalerite has shown these lines to be crystallographic directions. X375

roughly parallel northeasterly strike. Though they vary somewhat in composition, and in some places are so highly altered and sheared that their original nature is difficult to determine, they are all basic. In places they show the familiar diabasic texture, with lathlike feldspar crystals surrounded by hornblende. In others the feldspar grains are less elongated and are as large as $\frac{1}{8}$ in. in diameter. Still others now consist mainly of serpentine and chlorite and were probably orginally peridotite.

Microscopic examination shows the more typical variety of dike rock to consist of a feldspar near labradorite in lath-like lattice texture with about an equal quantity of ferromagnesian minerals. The dark constituents appear to have been derived from pyroxene, but are now mainly hornblende and its alteration product, chlorite. This particular rock and most of those dikes which are connected with mineralization are typical diabase.

In width, the veins vary from a few inches up to 5 ft. and, in one case at least, attain a width of 20 ft. or more. The gangue is chiefly quartz, glassy in appearance. Occasionally it lines vugs or shows comb structure, but the veins are usually "tight." Mineralization varies from quartz with coarse-grained sulphides to a replacement of dike rock by a mixture of quartz and fine-grained arsenopyrite. Chief sulphides are arsenopyrite, pyrrhotite, sphalerite, galena, pyrite, and a little chalcopyrite. In places, tetrahedrite and ruby silver become prominent. I found molybdenite in quartz in the float, but did not notice it underground.

Aside from the ruby silver and a little argentite, the silver content of the ores is uniformly associated with galena. In the absence of the latter mineral, sphalerite and arsenopyrite carry little silver.

Gold values are not definitely associated with any one mineral. Certainly they are not consistently proportional to the lead content, as pure galena in most cases shows only a gram of gold, whereas material assaying under 50 per cent lead has given gold assays up to 11 oz. per ton in hand specimens. Arsenopyrite is not necessarily an indicator of gold, as some specimens carrying as much as 10 per cent iron, mainly as arsenopyrite, gave only 0.02 oz. In short, the gold values are not in the galena, but may be either in some of the arsenopyrite or free in the gangue. There is no fixed relation between gold and silver content.

Sequence and Texture of Minerals

As usual, quartz is the earliest mineral of the veins. Oddly enough, pyrite is absent in the early stages. Arsenopyrite, the oldest sulphide, shows its habitual tendency to form crystals of its own shape within the quartz. Sometimes it molds itself around quartz crystals, occasionally corrodes quartz slightly, and in places cuts through it in veins. Sphalerite is still later and cuts the arsenopyrite in irregular veins, but has a marked propensity for replacing quartz. Some areas of sphalerite in arsenopyrite have the perfect outlines of quartz crystals, and incomplete stages of this replacement process may also be noted.

The sphalerite contains minute blebs of chalcopyrite, a relation very common in blende formed at relatively high temperatures.[2]

The inclusions are on the order of 0.01 mm. diameter, though many are larger and some are smaller. In places they tend to arrangement along straight lines, which may be parallel, often following crystallographic directions. Some of the inclusions are elongated and gash-like; and there are all gradations from this type to the rounded blebs. In addition, there are hair-like veinlets of chalcopyrite, which cut the sphalerite, and some of these pass into quartz or tetrahedrite veins. They cut the directions of the lines of blebs at all angles, and though in places they intersect them, there is no enlargement of the veins near the blebs. It is concluded that the chalcopyrite veinlets are not only later than the sphalerite but also later than the rounded inclusions.

The pyrrhotite is largely altered to marcasite, which occasionally shows concentric textures like those described by Gilbert[3] and Newhouse,[4] and are believed by them to be of supergene origin. From the altered pyrrhotite, veins of marcasite pass out into the adjoining sphalerite and chalcopyrite.

Later than the whole generation of arsenopyrite, pyrrhotite, and sphalerite, galena mineralization has affected only portions (though large portions) of the veins. There are whole stretches of vein matter which consist of only quartz, arsenopyrite, and pyrrhotite, and the absence of the later minerals marks an unmistakable break in the sequence.

Galena extensively replaces sphalerite in "sea and island" texture. In some of the ore, tetrahedrite is intimately associated with galena. The boundaries are smooth, and neither mineral has been noted veining the other. In general the tetrahedrite areas tend to be sur-

[2]See Teas, L. P., *Trans.* A.I.M.E., Vol. 59, p. 68, 1918.

Schneiderhöhn: "Entmischungserscheinung innerhalb von Erzmischkristallen und ihre Bedeutung für Laggerstättenkunde. *Metall und Erz,* Vol. 19, 1922.

Also Newhouse, W. H.: "An Examination as to the Intergrowth of Certain Sulphide Minerals." *Econ. Geol.,* Vol. 21, p. 68, 1925.

[3]Gilbert, G.: "Oxidation and Enrichment at Ducktown, Tenn.," *Trans.* A.I.M.E., 1924, No. 1318.

[4]Newhouse, W. H.: "Paragenesis of Marcasite." *Econ. Geol.,* Vol. 20, 1925, p. 54.

rounded by galena, and if there is any difference in age between the two, the galena appears to be later.

A late generation of quartz gangue cuts and brecciates the sphalerite and galena. Pyrite appears here for the first time. Vugs which are probably solution cavities in the earlier ore are lined with quartz crystals and pyrite cubes, and occasionally by chalcopyrite.

In one orebody recently opened, ruby silver is conspicuous. Pyrargyrite occurs in the galena in rounded areas, which typically have a subtriangular or boot-like shape. Only in one specimen was ruby silver seen following a cleavage crack in galena. The pyrargyrite is in places cut by tiny veinlets of chalcopyrite.

Professor C. P. Berkey,[5] working on specimens not available to me, finds a still later stage of pyrargyrite and proustite, along with carbonates, chalcopyrite, bornite, and arsenopyrite, and a final generation of carbonate, quartz, and micro-quartz. The sequence is:

Early Stage

(1) Quartz, (2) arsenopyrite, (3) pyrrhotite, (4) sphalerite.

Galena Stage

(1) Galena and tetrahedrite, (2) quartz, pyrite, and chalcopyrite.

Late Stages

(A) (1) Pyrargyrite, (2) chalcopyrite, (3) quartz.
(B) (1) Carbonate, chalcopyrite, bornite, arsenopyrite, pyrargyrite, proustite (Berkey).

Final Stage (Berkey)

Carbonate, quartz, chalcedony.

Near the surface, the ore of the late stage shows a little alteration of the galena and ruby silver. Galena is changed along cleavage planes to anglesite, and bordering these veinlets there is usually a gray rim of argentite. More highly decomposed material consists of pulverulent black, sooty argentite. Veinlets of similar nature form a network in the pyrargyrite. Around the chalcopyrite a little chalcocite and covellite appear.

The fact that the dikes are definitely cut by mineralized fractures shows that the basic intrusive had completely solidified before the veins were formed. How much time intervened between dike intrusion and mineralization it is impossible to state. In many parts of the world, basic "complementary dikes" follow granite intrusion and are believed to be a late differentiate from the same magma which formed the batholith or stock. In some cases these basic dikes are earlier than ore mineralization, and in others later; but frequently the ore and dikes are closely related in time. At Atlin the dikes are earlier than the ore, and their function was merely to localize fracturing by furnishing lines of weakness. If, by analogy with other deposits, the dikes, granite, and veins are closely related in time, they may all be surmized to have been derived from a single underlying magma—that of the Coast Range batholith.

The occurrence of ruby silver in the same vein system with pyrrhotite, a mineral commonly of high temperature, points to a later age for the silver minerals, and the textural relations bear out this expectation. Though in such circumstances the ruby silver might be strongly suspected of being secondary (supergene), the occurrence of galena (almost universally a primary mineral), distinctly later than the ore of the oldest stage, shows definitely that there were at least two generations of primary mineralization. The textural relations of pyrargyrite and galena and the failure of pyrargyrite to follow fractures and cleavage cracks, as did the secondary anglesite and argentite, together with the fact that the ruby silver is unquestionably earlier than the recognized secondary minerals, strongly suggests a primary origin for the pyrargyrite. Certainly the latter mineral did not form under the ordinary acid conditions of secondary enrichment, since all data concerning the artificial preparation of pyrargyrite[6] show that it forms under alkaline environment. Furthermore, the ruby silvers are here shown to have formed under conditions in which quartz and chalcopyrite could deposit without the formation of chalcocite and covellite. On the whole, the evidence, though not conclusive, points to a late primary origin for the ruby silvers.

Fig. 2—Hair-like veinlets of chalcopyrite cutting sphalerite which also contains rounded chalcopyrite inclusions. X 375

There is a possibility that at the time of ore deposition the dikes were still warm; that in this way the rock temperature during the early stages was higher than would be normal at shallow depths; and that the gradual cooling of the dikes during the several stages of ore deposition may explain the wide range of temperature conditions. Thus, we may have a "telescoped" sequence similar to that observed in veins in the Tertiary lavas, wherein the early high temperature is due to dikes, rather than to lava flows.

[5]Private report consulted through the courtesy of the Atlin Silver Lead Mines.

[6]Grout: "Alkaline Extracts of Metallic Sulphides." *Econ. Geol.*, Vol. 8, p. 140, 1913.
Ravicz: *Econ. Geol.*, Vol. 10, p. 368,392, 1915.

In Early Issues:

Mr. Owen Letcher will review the latest developments in the copper situation in the Belgian Congo.

Dr. T. T. Read has contributed a stimulating discussion of various principles involved in the sampling of ore.

DISCUSSION

Carson's Counsel Replies

THE EDITOR:

Sir—After the recent decision of the Court of Appeals in the Anaconda case, we filed a waiver of the issue of privity between the Anaconda and American Smelting, and requested an early decision on the merits. This was done solely for the purpose of avoiding delay and expense which would necessarily be incurred if the case were sent back to the lower court for the purpose of taking testimony on the question of privity. Furthermore, the question of privity is to a certain extent of a technical character, and we preferred to have the Court of Appeals decide the case on its merits. Besides this, a decision in favor of Carson in the Anaconda case on the ground of privity would not be binding in the other cases now pending against other infringers in which the question of privity does not arise. Under these circumstances, we waived the question of privity.

It may be of interest to the public to know that by its recent decision in the Anaconda case the Court of Appeals settled for all time the binding effect of the decision against the American Smelting & Refining Company. The following excerpt from the decision of the Court sustains this assertion, viz:

"It is very clear that the decree of this court in the American Smelting & Refining case in its essence and substance was final as to the validity of the patents involved, and as to the fact that there had been infringement. The questions of novelty and infringement were the pivotal ones before the court. They were considered and conclusively disposed of by our decree; hence they were finally settled."

This settles conclusively and for all time the finality of the decree against American Smelting & Refining Company, and the only thing left in that case is to ascertain the amount of money due from American Smelting & Refining Company for its infringement of the Carson patents. That matter is now in process of determination before a Master in Chancery at Tacoma.

JOHN H. MILLER.

San Francisco.

* * *

How to Obtain Xanthate in an Emergency

THE EDITOR:

Sir—From time to time letters have appeared in the Discussion columns of your publication from various people in regard to the emergency preparation of xanthate. It is evident that the writers refer only to emergency preparation of laboratory supplies, and in this connection I would suggest that the best way to get emergency supplies would be to address a letter or telegram to the Great Western Electro Chemical Company, No. 9 Main St., San Francisco, which will be glad indeed to furnish, gratis, laboratory samples by return mail or express.

San Francisco. C. T. HENDERSON.

* * *

Mineral Development Also a Feature of Canadian Railroad's Policy

THE EDITOR:

Sir—I have been interested in your editorial in the Jan. 7 issue, and in Mr. Weigel's letter of Feb. 25 on "Progressive Railroads and the Mineral Industry." Since 1919 the Canadian Pacific Railway has maintained a development branch with offices at Montreal and Winnipeg and recently at London, England, and has employed a staff including mining engineers, geologists, and agriculturists. The purpose of the branch is to further the development of Canadian natural resources, and its services are gratuitous. To this end considerable work is done of an informative type in replying to inquiries of a general nature. A series of 58 synopses covering the situation of various raw materials in Canada, revised each year, is issued. These cover each subject in a general way under such headings as description, sources, uses, Canadian statistics, and Canadian and U. S. tariffs. Advice and assistance are given to prospectors and operators in territory on the company's lines. There is no encroachment, of course, on the field of the consulting engineer.

Reports on a great many properties throughout Canada, made by its own staff, are on file and are available.

The branch serves as a connecting link between the producer and consumer, and also serves in an advisory capacity to other departments and officials of the railway.

Although as a rule no laboratory tests or experiments are made for the public, the branch retains a chemist to test materials for its own information. Minerals sent in to the branch are identified for interested persons.

G. G. OMMANNEY,
Director of Development.
Canadian Pacific Railway,
Montreal, Canada.

War Minerals

THE EDITOR:

Sir—There is a relationship between the two editorials appearing in *Engineering and Mining Journal* entitled "A Cross Section of Opinion on Reserving War Minerals" (Feb. 4) and "War Minerals Relief Again" (Feb. 11) which I would like to point out.

Practically all minerals are, in a sense, war minerals; but the volume of consumption for most if not all of them is much greater during a war than in peace times. It might be well then to define as "war minerals" those that cannot be produced in this country at peacetime prices in quantities to supply wartime needs. This would narrow the list materially, and, aside from tin, which is practically non-existent in the United States, the principal minerals would be chrome and manganese.

So far as the chrome deposits are concerned, with the exception of one in Montana and possibly one or two others, there is no doubt that the California operator quoted in your editorial of Feb. 4 is correct in his belief that they can best be conserved by leaving them in the ground, unless mined and stored by the government itself. Many manganese deposits, also, are in the same class; but large ones, and especially those requiring plants for beneficiation, could not be brought into production promptly unless previously developed and equipped. To mines of the latter class, the suggestion made by the Arizona operator, as quoted in the last paragraph of your editorial, would be applicable. And here, in my opinion, is the crux of the whole matter. The government does not buy war minerals, but buys equipment, in the manufacture of which war minerals are used. Until this is changed, or until a generation of chrome and small manganese producers arises which has forgotten the experience of the last war, it will take more than developed ore to obtain prompt production. In other words, the spirit to produce must be developed also.

To relate a little now ancient history: I went to Washington in 1917 to see what service I could render to help win the war, and among others upon whom I called was a former client, Mr. Alexander Legge, who was then chief of the Raw Materials Division of the War Industries Board. He said among other things, "Go right back to California and see what you can do toward stimulating the production of chrome." Of course, it was not an official order, but nevertheless, in the spirit, perhaps, of Don Quixote, I attempted to carry it

out. Later, there was an official connection with the Bureau of Mines, which led me to Cuba and back again, during 1918, to California and Oregon. During the remaining months of the war I met many men who had commenced the production of chrome and manganese on a relatively small scale, and I have met several of them since.

I know that many are still dissatisfied with the awards of the original commission, and some of them, notwithstanding your editorial of Feb. 11, I believe are justly dissatisfied.

It is true that very few of them undertook the work from patriotic motives and most of them were simply small-scale war profiteers. They sold their output to others who were profiteers on a larger scale. And here was where they lost out at the end; for the larger profiteers were able to influence the Shipping Board to divert vessels from troop transportation to the importation of chrome and manganese from abroad, leaving the small producer in the West with no market toward the close of the war.

Doubtless many false claims were made to the War Minerals Relief Commission and doubtless some were allowed. On the other hand, men with just claims, but with little business experience, were unable to make equally clever presentation of their cases, and their claims were disallowed by the commission, which I believe was honest and inclined to be just; but I fear it was not sympathetic. At that, it is doubtful whether, if the new bill for relief should prevail in Congress, much additional money would go to the most deserving. Many of them have become more or less discouraged and will not try again.

All of this leads back to the conclusion that for any future war all industry should be mobilized and raw materials purchased directly by the government for resale at fair prices to consumers; and, in the case of some war minerals, it might be wise for the government to purchase and store a supply in advance.

ALBERT BURCH.

Medford, Ore.

[Mr. Burch's comments are timely, fair, and constructive. We believe, however, that a diversity of opinion may exist in regard to the attitude that should be shown by a commission entrusted with the duty of disbursing government money. Mr. Burch contends that the commission in question was not sympathetic; but it might well be suggested that a dangerous precedent would be set if that emotion were allowed to form the basis of decision in a matter of this character. Mr. Burch refers, also, to the collapse of the market for domestic chrome ore toward the close of the war. It will be remembered that on account of the scarcity of ships the President placed an embargo on certain commodities, including chromite, in June, 1918. In spite of this embargo a considerable amount of chrome ore was brought in as ballast. As a direct result, domestic producers suddenly found that the stock of chromite on hand was larger than had been calculated upon. The quantity was much greater than industrial needs required, and the natural result was that the bottom dropped out of the market. This occurred several months before the armistice.—EDITOR.]

* * *

The Short-Circuiting Ventilation System

THE EDITOR:

Sir—The article entitled "Two-Fan Installation for Ventilating Mine Workings," by Walter S. Weeks, in the *E. & M. J.* of Feb. 18 has been studied with much interest. The logic and theory upon which Professor Weeks has built up this interesting experiment cannot be denied. However, as an actual installation it is difficult to see its practicability or even its safe application.

Such a system must of necessity operate in a practically perfect balance. The pressure at *b* as developed by fan *A* cannot be less nor more than that developed by fan *B*. If it is greater, fan *B* must work against fan *A*. If less, fan *A* must work against fan *B*. Such a fine balance of pressures of two fans would be hard to maintain, especially in metal mines, in which conditions are constantly changing. Regulators would have to be adjusted frequently. And should some careless workman leave an important door open, his action might upset the system entirely.

Five inches of water gage is a high pressure to maintain on a worked-out level. This objection would of course not hold if the crosscut containing the fan and connecting the two airshafts is absolutely devoid of inter-level connections or connections with other workings on that level. However, such is rarely the condition, and it is with the greatest difficulty that such connections as usually exist can be closed off. The result would be large leakage losses and a corresponding drop in the fan pressure at *b*.

Intake and outlet shafts are as a rule a considerable distance apart. Would any progressive management consider spending the amount of money necessary to make a satisfactory connection between such shafts, and keep a fan in operation for the express purpose of recirculating warm, ill-smelling, moisture-laden, and possibly smoky air—air which ought to be sent to the surface by the shortest possible path without further coming in contact with men or timber?

Some provision has been made for contingencies, such as mine fires. I feel that this has not received sufficient consideration. How frequent is it that the fire is discovered and acted upon only by those on top when smoke is seen pouring out of the return airshaft? The air travels only one-quarter as fast from *e* to *f* as from *b* to *a*, thus giving fan *B* ample opportunity to begin recirculating the smoke before the fire is discovered on top. In that circumstance, what of the men below *b—e*? Assuming that the discovery of a mine fire is timely, but that the fire is already of such proportion that help is necessary, and that it would require only a short time to relay the message to the surface, one must remember that to maintain a velocity of 250 f.p.m. in working places it will be necessary to have air velocities of over 1,000 f.p.m. in the main air courses. Under such conditions it is not hard to imagine a fire in the mine, a short-circuited ventilation system with its high velocities, fanning the flames and carrying the smoke to the intake side, and men rushing to the airshaft only to find smoke and gases pouring down upon them.

In going back over the history of mine fires in which lives were lost, one frequently finds in the reports of investigators that the fan was not properly handled at the time of the fire. If such is the condition with one fan, what can be expected where two major ventilators are employed as suggested? But even if fan *B* is shut down *as soon* as word is received, in view of the fact that it transfers the return air back to the intake shaft, and imparts a high velocity to it, that "as soon" would no doubt be too late.

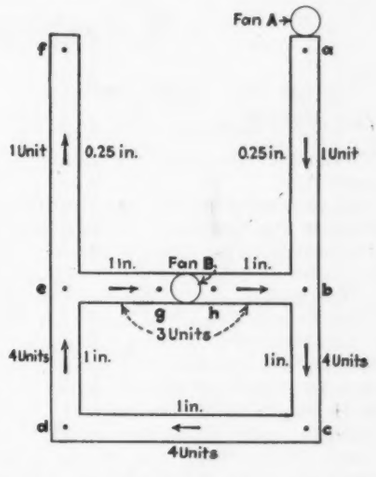


Diagram of short-circuiting ventilation system, reproduced from article by Prof. W. S. Weeks

It is my belief that it would be far better to improve the air courses, use only one main fan, eliminate the foul air from workings as early and as often as possible, and thereby maintain a healthier atmosphere underground.

One does not have to search far in the annals of mining history to find mine-fire disasters. When a fire breaks out, it is the ventilation system which will save or destroy life, depending on how good the system is, how thoroughly it is understood, and how well emergency problems have been worked out in advance. It should be the duty of mining engineers in general and those in control of ventilation in particular to see that the entire system is as fool-proof as possible, and that it is flexible to the *n*th degree in order that any condition may be met effectively and immediately. Such a system can

be built up only by the simplest and most direct means possible.

It is shown that if fan *A* is made to deliver 4 units of air from the surface, 44 power units are required. Whereas, if fan *A* delivers only 1 volume, and fan *B* recirculates 3 volumes, the total power consumption of both fans is only 18.5 power units, which constitutes a material saving.

POWER FACTOR DATA

I cannot agree with all the assumptions, nor do I believe that the calculations were carried far enough. It is assumed that 4 volumes of air are required regardless of its quality. If all the air came from the surface, cool and fresh, with a drying power many times that of the proposed mixture, it surely would not require as much as if three-fourths of all the air circulated is warm and humid before entering the working places. It would therefore be of interest to see just what volume could be delivered through the mine with fan *A* if the same power were applied as in the two-fan system.

Power Available 18.5 Power Units

	Inches
To force 4 units from *b* to *e* requires	3
To force 1 unit from *b* to *e* requires	0.1875
To force 1 unit from *a* to *b* requires	0.25
To force 1 unit from *e* to *f* requires	0.25
To force 1 unit from *a* to *f* requires	0.6875

Using the same method of calculating, but starting with the power units and figuring back to volume:

$$\text{Power} = p \times v$$

$$\text{for 1 unit } p = 0.6875$$

$$\text{for } v \text{ units } p = \left(\frac{V}{I}\right)^2 \times 0.6875$$

$$\text{substituting power} = v^3 \times 0.6875$$

$$\text{or } 18.5 = v^3 \times 0.6875$$

$$v = 3-$$

In other words 18.5 power units applied to fan *A* would result in 3 units circulating through the mine without any recirculation whatever. The 3 units so circulated would be fresh uncontaminated air, and would more than compensate for the additional unit which could be circulated by the short circuiting method. OSCAR A. GLAESER,

Ventilation Engineer, United Verde Copper Company, Jerome, Ariz.

Consultation

World's Largest Gold Mine

"What is the world's greatest gold mine?"

No conclusive answer can readily be given to this question: several mines have a reasonable claim to the distinction, depending on how the term "greatest" is defined. At the time of the visit of the British Empire Mining Congress to the Porcupine district, in northern Ontario, last summer, the subject was naturally discussed in connection with the Hollinger mine. Dr. Samuel Evans, chairman and managing director of Crown Mines, Ltd., one of the great companies on the Rand in South Africa, computed the accompanying table from data given in the annual reports of the various companies for the year 1926. For purposes of comparison the Hollinger figures are converted to sterling —pounds, shillings, and pence. It might be argued with justice that some of the companies operate groups of mines rather than single mines; but taking the figures on their face, it is seen that no definite answer to the question asked by the correspondent can be made.

New Modder paid the biggest dividends, though it did not realize the largest gross working profit, that distinction going to Government Areas. Nor was it the leader in the matter of gold produced, both Government Areas and Crown Mines exceeding it in this respect. Hollinger came fourth in total yield, and third in working profit, by virtue of low per-ton working costs. Indeed in this particular it was the premier, being slightly under Government Areas. Crown Mines leads in the point of total tons of ore milled, and it might be argued that it consequently was the biggest if not the greatest of the lot.

Operating Results at World's Large Gold Mines

(Summary of 1926)

Name and Location	Tons Milled	Value of Yield — Total £	Value of Yield — Per Ton s. d.	Working Costs — Total £	Working Costs — Per Ton s. d.	Working Profit — Total £	Working Profit — Per Ton s. d.	Dividend £
Hollinger, Ontario	1,9..2,559	3,037,221	31– 5	1,568,043	16– 3	1,469,178	15– 2	1,192,97
Crown Mines, Rand	2,611,000	3,510,800	26–10	2,463,268	18–10	1,047,532	8– 0	553,838
Randfontein, Rand	2,304,000	2,448,436	21– 3	2,121,141	18– 5	327,295	2–10	.....
Government Areas, Rand	2,239,000	4,314,519	38– 6	1,831,702	16– 4	2,482,817	22– 2	1,015,000
East Rand Proprietary, Rand	1,577,590	1,687,525	21– 5	1,621,287	20– 7	66,238	0–10	.....
New Modderfontein Rand	1,551,500	3,488,486	44–11	1,423,625	18– 4	2,064,859	26– 7	1,610,000

Stemming and Tamping

"Quite a long time ago I read with interest an article about 'stemming'—a method of making fine muck in blasting. I have asked old and experienced miners just what is meant by 'stemming,' but so far none of them has been able to explain just what the term means. Would you mind explaining it more fully?"

The term "stemming," as ordinarily used, is merely another name for "tamping," with which all the old and experienced miners are familiar. It merely consists in forcing a layer of damp clay or sand down on top of the explosive charge in the drill hole. In wet holes where gelatine dynamite may be used for the explosive, water may serve as the stemming material. A. H. Fay, in his glossary of mining terms, makes a distinction between the terms "stemming" and "tamping" as follows, though it is our impression that this distinction is not generally observed: "Stemming: A term applied in mining literature to the inert material used on top of a charge of powder or dynamite, while tamping is reserved to indicate only the process of compressing the stemming in place."

* * *

Geophysical Exploration Companies and Apparatus

"What companies are engaged in geophysical exploration work? Also what companies are manufacturing apparatus for such work?"

In answer to the first part of this question the following list of geophysical exploration companies is given:

Swedish American Prospecting Corporation, 26 Beaver St., New York.

Schlumberger Electric Prospecting Methods, 25 Broadway, New York; also 62 Front St. West, Toronto, Canada.

The Taumac Corporation, 342 Madison Ave., New York, N. Y.

The Radiore Company, Hollingsworth Building, Los Angeles; and 96 West St., New York.

Physical Exploration Corporation, 1865 Monroe St., Madison, Wis.; also 111 Broadway, New York.

Geophysical Exploration Corporation, 30 Church St., New York.

North American Exploration Company, 71 Broadway, New York (which is affiliated with the following company).

Geophysical Company of Canada, Limited, 703 Reford Building, Toronto, Canada.

Geophysical Company, Ltd., London, England.

Geophysical Research Corporation, 65 Broadway, New York.

The foregoing list is believed to be complete, so far as companies having headquarters in the United States are concerned. Readers will confer a favor by bringing to our attention the names of any that have been omitted.

Among the companies manufacturing or dealing in apparatus used in geophysical prospecting may be noted:

Askanie Werke A. G., 1024 Keystone Building, Houston, Texas (manufacturers of torsion balances, magnetometers and the earth inductor). This firm is the American branch of a Berlin firm of the same name.

Dr. George Steiner (representing Eötvös Geophysical Institute, Budapest, Hungary), 1802 California St., Houston, Tex.

L. Oertling, Limited, 88 Turnmill St., London, E.C.1, England (Eötvös torsion balance).
Fr. J. Berg, Stockholm, Sweden.
Exploration Boden untersuchungs und Ververtungs G.m.b.h., Linkstr. 25, Berlin, W.G., Germany.
Gesellschaft für praktischen Geophysik (address unknown), Germany.
Ferdinan Züss Institute of Budapest, Hungary (Eötvös torsion balance).
Société d'Entreprises Electro-Techniques, 35 Rue du General Foy, Paris, France.
Keuffel & Esser Co., 127 Fulton St., New York (dip needles).

Some of the geophysical exploration companies manufacture in their own laboratories the apparatus used by them in their work.

* * *

Marketing of Chrome Ore

"What are the usual limiting amounts of impurities acceptable in chrome ore of various grades? Is there any market for ores containing less than 40 per cent of Cr_2O_3, or from 40 to 45 per cent Cr_2O_3? What premiums or penalties obtain on ore of higher or lower grade than covered by the usual quotations on 45 to 50 per cent ore?"

Most buyers of chrome ore are satisfied if the chrome and iron contents are stated, though sometimes the percentages of silica or alumina are also desired. Buyers for the steel or ferro-alloy industries usually desire an ore containing not less than 45 per cent chromic oxide and an iron content not exceeding one-quarter of the combined iron and chromic oxide. For instance, if the chromic oxide content is 45 per cent, the iron must not exceed 15 per cent. The chemical trade requires the chromic acid content to be 50 per cent or better, but is not so particular about the iron content, and the limit already given might be exceeded by 1 or 2 per cent. Refractory manufacturers demand low silica, generally below 5 to 8 per cent.

Ore of low chromic acid content is acceptable to the ceramic and brick industry, though of course it does not command so high a price. As low as 38 per cent chromic acid is quite commonly accepted, and business has been done in even lower grades when the shipping facilities from mine to consumer were particularly advantageous, so that an unusually low price could be quoted.

No recognized standard exists for premiums and penalties. In sales to the steel and chemical trades it is customary to quote a price per ton based on a definite percentage of chromic oxide —say $20 for 50 per cent material, with an allowance of 40c. for each unit above or below this analysis. The brick and refractory trades, however, buy ordinarily "as is," with a guaranteed minimum content of chromic acid and with no premium for a better quality than is specified.

By the Way

Unsuspected Benefits of Aërial Mapping

IN ANOTHER PART of this issue there is a short article on aërial mapping in Canada, but the author does not touch at all on one phase of the matter that inured to the benefit of one Canadian company. Hugh S. Spence, of the Department of Mines at Ottawa, who dropped into the office to say "Hello" the other day, told us that when a print was made of an aërial photograph of one property, sharp inspection disclosed a distinct path running through the bush up to a high wall which bounded one side of the company's property. No reason could be adduced why this path was there, but inspection proved that it indeed existed, so a watch was kept to find out the why and wherefore. It was found that employees, working inside, had been making a practice of throwing valuable scrap materials, supplies, and pieces of equipment over the wall to confederates standing below, who then made off with them along the path in the underbrush, well shielded from discovery except from overhead.

* * *

Price Cutting and Price Courage

PRODUCERS of raw materials, including non-ferrous metals, are not alone in suffering from the effects of price cutting. The following editorial from the *Electrical World* takes the point of view of the manufacturer of electrical machinery and equipment:

"Price cutting is under very active discussion at the moment. There are two viewpoints. The purchasing agent is charged with taking unfair advantage of the manufacturer in this buyers' market and doing injury to the industry by beating down price levels and demoralizing values. The manufacturer is criticized for voluntary and precipitate price cutting impelled by eagerness for orders. Not all purchasing agents are indicated, of course, and not all manufacturers. But there is evidence enough to make the picture a distressing one, despite a vigorous defense by the buyer, that this is just the good old battle between the forces of supply and demand.

"It is interesting to note, however, that there is one feature of the argument in which both sides are in accord. Manufacturers as well as purchasers agree that the power of 'yes or no' lies in the hands of the seller. His ability to use it depends upon his courage. And there is no substitute for courage. But price courage is largely a matter of organization. For the most courageous salesman is apt to be the one who has the most courageous boss. And the company with the strongest price policy is usually headed by an executive who in a pinching market would rather sacrifice volume and loss in idle capacity than cut prices and compromise the principle that goods should not be sold at a loss. It is easy to talk about price courage. It is hard to battle in the market place. But price cutting is contagious. It is infectious. The manufacturer cannot escape his responsibility both to protect himself and to defend the economic soundness of values. There cannot be too much discussion on this point."

* * *

Fordizatsia

THE DEAREST wish of the Soviet leaders, says Walter Duranty in the New York *Times,* is a seven-hour day for workers—Ford introduced the five-day week, yet manages to pay the highest salaries. Cheap mass production is a Soviet goal, more precious from the practical standpoint than world revolution—Ford in Soviet eyes is the arch-mogul of that achievement. "Fordizatsia" — "Fordisation" — has become one of the "words of power" with which Soviet orators spellbind auditors.

To the Russian masses fat words like electrificatsia, rationalisatsia and industrialisatsia bring a soothing balm with which no "religious opium" can vie. But nowadays Fordizatsia "leads all the rest," and it is the proudest boast of the Soviet factory that "today we completed the installation of a conveyor system, increasing production N per cent and reducing costs X per cent."

The Soviet press obligingly chronicles this fact under a stereotyped scarehead, "New Success of Fordizatsia."

In reality, according to this authority, the Soviet authorities are less interested in political recognition than in the establishment of business relations with the United States. They feel that the former would facilitate the latter by bringing about the residence of American Consuls in Russia and later a commercial treaty. Otherwise they feel somewhat discouraged over the recognition question as a whole.

* * *

Knowledge and Learning

OUR ESTEEMED contemporary, *Industrial and Engineering Chemistry,* begins an editorial in the current issue thus:

"That a little knowledge is a dangerous thing is another way of saying that failures in business begun upon what seemed to be an adequate research foundation occasionally occur."

It is to protest. Knowledge in any dosage is beneficial, never dangerous. The hazard, as Pope saw and anticipated with keen perception, lies in a too superficial education. To quote the reference in its entirety:

"A little learning is a dangerous thing;
Drink deep, or taste not the Pierian spring:
There shallow draughts intoxicate the brain,
And drinking largely sobers us again."

INDUSTRIAL PROGRESS

The Equipment Review

EQUIPMENT recently announced for mining and metallurgical purposes is described in the following. Statements made as to construction, service, and performance are for the most part to be credited to the manufacturer.

Power Shovels

The fact that the Marion Steam Shovel Company had undertaken to build a 15-yd. electric shovel, which was to be strengthened throughout as compared with the 350 Model, was announced in the Annual Review Number of Jan. 21, 1928, on page 139. Construction work has been progressing steadily since then, and it is expected that the shovel will be put into service on May 1 next. It will have a 120-ft. boom and an 82-ft. dipper stick. Interesting comparisons may be made regarding its performance. With its long boom the shovel will be able to lift material to a height of 90 to 100 ft., approximately that of a ten-story building, and to cover a circular area within 150-ft. radius. Therefore, if placed in the center of an ordinary football field, it could dig out the entire field and deposit the dirt on the bleachers. This could be done at remarkable speed, because of the capacity of the dipper. One dipperful would fill a trench 1 ft. deep, 6 ft. wide and 65 ft. long.

The shovel will weigh approximately 1,350 tons, the previous record weight, it is said, for any shovel being 550 tons. It will be mounted on four caterpillar trucks, each of staggering size. It will be self-propelled, a recent development in the design of large shovels. Ward Leonard control will be used. A 1,700-kva. motor will drive the generator. The hoisting motion will be effected by means of two 450-hp. variable-voltage, heavy-duty, steel-mill-type motors operating at speeds up to 500 r.p.m., according to the work done. Two 150-hp. variable-voltage motors will provide the swing motion. These will have a maximum speed of 1,000 r.p.m. The dipper trip will be operated by a motor rated at 100-ft.lb. torque. The main motors are of a type and size used in the past only on steel-mill main-roll drives and mine hoists. General Electric is furnishing the power equipment.

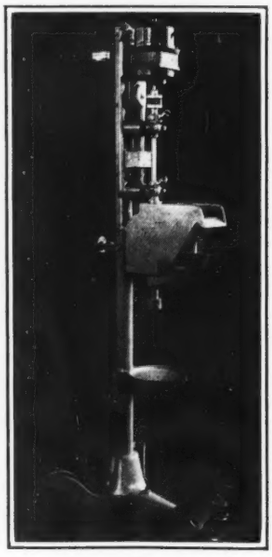
Dragline buckets for severe service are being made by the Harnischfeger Corporation, Milwaukee, in sizes ranging from ½ to 1½ cu.yd. The bottom and sides of this bucket are shaped from a single piece of heavy tank steel, all seams being electrically welded. Bucket teeth are heavy steel forgings, securely bolted to the bucket. The design is such, it is said, as to eliminate the difficulty of the sides being drawn together at the front.

Transport

The Allis-Chalmers Manufacturing Company has purchased the Monarch Tractor Corporation, of Springfield, Ill., makers of crawler or tank type tractors. The Monarch organization is reported to have developed a successful line of tractors of this type and to hold valuable license arrangements. This purchase marks the entrance of the Allis-Chalmers company into the industrial tractor field.

Conveying

Belt carriers have been standardized by the Jeffrey Manufacturing Company, Columbus, Ohio, for its belt conveyors, so that the same stands and bases can be used with any one of the three types of pulleys—namely, the plain bearing, the bronze bushed, and the roller bearing. These pulleys are of gray iron and are made with open sides to minimize dust collecting near the bearings. In place of the solid ends, each pulley has three arms adjoining the hub and roll, with six ribs between the arms to afford additional rigidity lengthwise. It is said that the free carbon in the gray iron acts as a rust preventive.



A new laboratory flotation machine

Mine Support

For lining tunnels and other underground passages where permanency and safety are required, the Commercial Shearing and Stamping Company, Youngstown, Ohio, is making a line of steel mine arch plates. These plates, which are light enough to be handled easily, are bolted together to form the desired arch for the roof. The space left between the arch plates and the original roof is then packed with waste material to prevent sudden pressure from falling ground. As the plates are put in position, they may be coated to protect them against corrosion.

Flotation

A new laboratory flotation machine has been introduced by the Ruth Company, of Denver It is operated by a 176-hp. Kimble special reversible and variable speed vertical motor (500-2,000 r.p.m., 110 volts, 50-60 cycles), to which it is connected by means of a flexible coupling. The approximate shipping weight is 250 lb. The machine may be furnished with any one of several tanks. It is radically different from present laboratory machines, according to the maker. It is shown below.

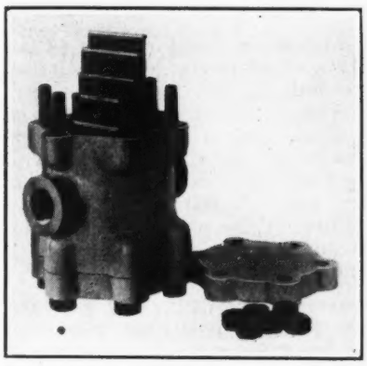
Power Plant

A new automatic stoker for boilers up to 200 hp. has been announced by Combustioneer, Inc., 570 W. Randolph St., Chicago, Ill. This device, it is said, will feed coal automatically to the fire bed, by the underfeed principle, distributing the fuel evenly over the entire bed. Thus air holes in the fire are eliminated, insuring uniform combustion and preventing blasts of air from impinging on the boiler.

What is said to be an ingenious method of storing steam and controlling its distribution is embodied in the Ruths steam accumulator, which has been developed by the Ruths Accumulator Company, Inc., 292 Madison Ave., New York, N. Y. Before this was accomplished it was not possible for an industrial plant to operate its boilers constantly at their most economical rating, because of the widely varying demands for steam from hour to hour, and even from minute to minute. Thus it was necessary to have boiler plants capable of meeting these conditions, and obviously they were operated most of the time below their capacity. With the Ruths system, it is stated, it is possible to operate boilers constantly at average load and still supply peak demands for steam and power. This system will be described at greater length in an early issue.

A new purifier, known as the "Pipeline Tracyfier," has been introduced by the Andrews-Bradshaw Company, a division of Blaw-Knox Company, of Pittsburgh. This is a smaller purifier developed for use in several sizes of air, steam, or gas lines up to 3 in. In saturated steam lines it removes all moisture from the steam and frees it from all solids, both soluble and insoluble. "Standard Specification" steam is delivered. As for air tools, one of these purifiers in the air line near the tools will make it possible to obtain clean air.

General Electric Company has announced a fully automatic control equipment for use with dynamometers in testing internal combustion engines.



A purifier for air, steam and gas lines up to 3 in. in size

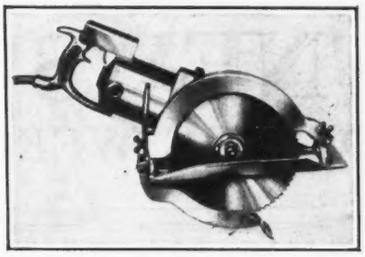
Although much of this work is in the nature of research, requiring very close accurate control of both armature and field, it has been found that the usual manual type of control can now be superseded by the automatic type.

The Lincoln Electric Company, of Cleveland, Ohio, has for years had a school of welding in its shop. Recently this has been reorganized and re-equipped. Its purpose is to train electric arc welders. No tuition or fees are charged.

Rock Drills

A new gasoline hammer, known as the "Rodax," which can be used with a cutting tool as a jackhammer drill, although its primary purpose is for pavement breaking, has been developed by the Milwaukee Gas Tool Corporation, Milwaukee, Wis. The new machine is simple and rugged in construction. The piston operates as the hammer, the blows being transmitted through an anvil direct to the cutting tool used. The unit is self-sustained and weighs about 85 lb.

An electric percussion rock drill, called the "Syntron," has been developed in South Africa, according to the *South African Mining and Engineering Journal* of Feb. 11, 1928. The reciprocating mechanism consists of two solenoids so arranged that when a current passes they give a reciprocating motion to a hardened-steel piston, which at one end of its stroke, when at its maximum speed, strikes the head of a steel bit, held in a socket. At the other end of the



New portable electric saw

stroke, the piston strikes against a shock absorber. The circuits of the coils are controlled by a trigger switch, which is the only electrical make-and-break. The only moving part is the piston. The machine weighs 45 lb., and will drill 6 in. of hole per minute, using three steels in a 42-in. hole. The chuck will take a $\frac{7}{8}$-in. square shank $4\frac{1}{2}$ in. long.

Electrical Equipment

Owing to the confusion of its name with that of a competitive company, the Cutter Electrical & Manufacturing Company, of Philadelphia, has decided to change its name to the I-T-E Circuit Breaker Company.

Consolidation of the Jefferson Electric Manufacturing Company and the Chicago Fuse Manufacturing Company has recently been announced. The new organization will be known as the Chicago-Jefferson Fuse and Electric Company, with offices at Laflin and 15th Streets, Chicago.

The Shop

Two new portable electrical hand saws have been introduced. One of these is the Type B saw developed by the Wodack Electrical Tool Corporation, 4627 West Huron St., Chicago. In addition to vertical sawing, it is capable of bevel sawing at any angle up to 60 deg. It is also provided with a width gage for vertical sawing, which can be set for any width up to 6 in. This saw is provided with a GE Universal motor of special design, for both a.c. and d.c. 110-volt, 220-volt and 250-volt circuits. It is furnished with one 11-in. and one 9-in. blade ready for use.

The other saw is the Junior Model J, made by Skilsaw, Inc., 3814 Ravenswood Ave., Chicago. This machine weighs 11 lb. It is designed for ripping and crosscutting dressed lumber up to 2 in. and is adapted for maintenance and other work. It has a $\frac{1}{4}$-hp. special motor for direct current or single-phase, 60-cycle alternating current. The body is of aluminum and the shaft and gears of chrome-nickel steel.

Fourteen American manufacturers of machine tools will have exhibits at the permanent exhibition which is to open next May in Moscow, according to an announcement by the Amtorg Trading Corporation.

General Electric has announced an addition to its line of electric heating equipment in the form of a pot-type electric furnace for lead hardening, for temperatures up to 1,650 deg. F. It is being marketed in four sizes. The smallest has a capacity of 75 lb. of steel per hour at 1,500 deg. F., and the largest a capacity of 250 lb. per hour at 1,500 deg. F.

A portable acetylene flare light has been introduced by the Oxweld Acetylene Company, 30 E. 42d St., New York. The fuel used is produced from Carbic, which is in the form of cylindrical cakes of uniform size. This flare can be used even in violent winds.

BULLETINS

SCREENS—N. V. Technisch Materieel, 142a Noordeinde, The Hague, Holland. Several catalogs covering Herrmann sieves and metal conveyors, precision sieves, Rastex sieves, jigging grates, perforated sheets, wire cloth, and metal conveyor belts. Some of these bulletins are in German; the others in English.

FLOTATION — The Ruth Company, Denver. A 16-page bulletin covering the Ruth standard type laboratory flotation machine recently deyeloped.

FLOTATION—Southwestern Engineering Corporation, Hollingsworth Building, Los Angeles. Bulletin 240. Southwestern air flotation machine. Eight pages.

BOILER PLANT—La Mont Corporation, 250 Fifth Ave., New York, N. Y. A folder covering the LaMontube screen for steam power plants. Four pages.

ARC WELDING—The Lincoln Electric Company, Cleveland. Catalog Section 1611. Supplies for the "Stable-Arc" welder. Eight pages.

MOTORS—General Electric Company, Schenectady, N. Y. Bulletin GEA-712A. Type BTA a.c. motors, 220, 440 and 550 volts. Four pages.

MOTORS—Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Bulletin 1118-E. Polyphase induction motors, Types AR and ARY. Sixteen pages.

ELECTRIC CONTROLLING APPARATUS—Allen-Bradley Company, Milwaukee, Wis. Several bulletins for loose-leaf filing covering switches, starters and other electric-controlling apparatus.

INSTRUMENTS — Sangamo Electric Company, Springfield, Ill. Bulletin 67, supplement. Type HC Sango meters. Eight pages.

HOISTS—Silent Hoist Winch & Crane Company, Inc., 762 Henry St., Brooklyn, N. Y. Bulletin 27. Vertical and horizontal capstan, single and double drum winches. Four pages.

HOISTS — Chisholm-Moore Manufacturing Company, Cleveland. Bulletin 31. The various types of hoists used in industry.

JACKS — Blackhawk Manufacturing Company, Milwaukee, Wis. A folder covering hydraulic oil-power jacks.

ROLLER BEARINGS—The International Nickel Company, New York. Two bulletins, one entitled "Roller Bearings in Railroad Service," of 4 pages, and the other entitled "Nickel Alloy Steels for Roller Bearings," also of 4 pages.

NEWS OF THE WEEK

Summary

HOUSE Committee on Mines and Mining urges passing of new War Minerals Relief bill. Secretary Work opposes it, saying all cases have already been reviewed thoroughly.

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Australian metal mining is in a doubtful condition. Gold and copper production has been declining steadily for five years. Industrial conflict is seen as its chief obstacle. A comprehensive summary of conditions is found on page 508.

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Nine killed in fire at Granby Consolidated Bunk house destroyed. Cause is unknown.

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Calumet & Hecla is developing its options on Keweenaw peninsula thoroughly. Quincy plans reopening No. 8 shaft.

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Ontario Legislature is now considering a number of bills designed to stamp out fraud in mining stock promotions.

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Anglo-Oriental is taking the lead in consolidating several Nigerian tin producers. New dredging machinery has been ordered for its properties from American manufacturers.

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Hudson Bay M. & S. plans to spend $10,000,000 on Flin Flon developments. Plans for a 3,000 ton plant are being drawn up.

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Work is resumed at Belmont mine of Anaconda Copper. Fire in Badger State is under control.

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Sterling mine, in Medford district of Oregon, is to be reopened. Mine was closed by litigation.

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Decree of Mexican Supreme Court designed to reduce the number of cases pending has resulted in renewing litigation in suits formerly dormant.

Mill Construction in Kootenay, B.C., Shows Development of District

Hewitt, Ruth-Hope Mining, Paradise, Lucky Jim, and Cork-Province Are Among the Companies Remodeling or Constructing Plants

MILL CONSTRUCTION during last year and the early part of this year in the Kootenay district of British Columbia has reached completion in many instances and is rapidly approaching it in others. The remodeled Ruth-Hope mill, at Sandon, has been put into operation and is treating about 60 tons daily. A few further alterations will be necessary before it can be brought to its capacity of about 125 tons. A large tonnage of ore has been developed in the western extension of the Silversmith lode in Ruth-Hope ground and in the old workings of the Ruth mine.

The remodeled Hewitt mill is treating about 60 tons daily, testing ore from the several mines that feed it. The Victoria Syndicate, of London, has completed a large amount of development on a big consolidation of claims, which includes the Hewitt, at Silverton, and the Carnation, Minnehaha, and Wakefield mines, above Sandon. A long tunnel has been driven through the crest of the mountain, to connect the Carnation and Wakefield, and an aërial tramway, some two miles long, has been erected, to connect these mines with the Hewitt mill. This work will materially cheapen production and, ultimately, will result in the treating of about 200 tons per day at the Hewitt mill. The Victoria syndicate, also, has put the 75-ton flotation mill at the Paradise mine into operation. This is an old mine, situated in the Windermere Lake district, East Kootenay, which the syndicate is developing under lease and option from the Hon. R. R. Bruce, Lieutenant Governor of British Columbia. The mine was staked in the early 'nineties, and has been worked fairly continuously since, but until the syndicate took it over only carbonate ore of shipping grade was mined. The syndicate has sunk below the zone of oxidation into a wide belt of lead-zinc-silver sulphide ore of a good milling grade.

Reserve of Ore at Lucky Jim to Be Developed

Construction on the Lucky Jim mill, at Zincton, is progressing steadily, but, as the mine produces chiefly zinc which, with high treatment charges, is not particularly profitable at present prices, the work is not being hurried. A large reserve of silver-zinc-lead ore is being developed.

Recent development at the Cork-Province mine, at Zwicky, has opened so much ore that the directors have let a contract for a 500-hp. hydro-electric plant, and will start work on the remodeling of the old gravity mill to a 200-ton flotation plant as soon as weather conditions are favorable.

Capacity of Britannia M. & S. Mill Increased to 4,500 Tons

Britannia Mining & Smelting has increased the capacity of its mill, at Britannia Beach, from 4,000 tons daily to 4,500 tons by the installation of a large rock crusher, in the raise below the new main haulage tunnel, which crushes all the ore on its way from the mine to the mill. Some small alterations and additions have been made to the mill itself. All of the ore, after crushing to 2-in. gage, is washed on $\frac{3}{16}$-in. screens. This removes soluble salts and clayey matter, which had interfered with subsequent flotation. The undersize and soluble matter comprises about 12 per cent of the whole, and, as it contains a considerable amount of copper, it is floated separately after it has been treated with from 6 lb. to 8 lb. of soda ash per ton, to precipitate salts of iron, magnesium, lime, and aluminum and generally to improve the condition of the pulp. The washing process has reduced the copper content of the tailing from 0.16 to 0.11 per cent, which on 4,500 tons per day means a saving of about 4,500 lb. of copper per day. The company's output of metal for 1927 was 34,950,177 lb. of copper, 10,337 oz., of gold, and 174,000 oz., of silver. Average daily output from the mine was 3,700 tons. With the increased tonnage now being treated, a corresponding increase in all metals may be expected in 1928. The company also produces 37,777 tons of iron pyrite concentrate, averaging 49 per cent of sulphur, and could produce considerably more of this material. It recently has installed a small electric furnace in which the manufacture of iron from roasted pyrite will be attempted in a small way. The Britannia is a subsidiary of the Howe Sound Company.

Merger Mine, Near Blue Tent, to Start Milling Soon

ACCORDING to H. B. Skews, superintendent, the Merger mine near Blue Tent, Nevada County, Calif., will start milling operations on April 1. Exhaustive tests have been made for the treatment of this ore, and the process now embraces milling, amalgamation, concentration, and cyaniding. A high-grade bullion will be produced.

North Star at Grass Valley, in the same district, is reported to have cut a ledge of high-grade ore on the 8,600 level. A. B. Foote, general manager, reports that drifting has been performed on the ledge for a distance of 50 ft. with excellent results. He says that it is not yet determined whether this is a distinct ledge extending into virgin ground, or an offshoot of the ledge from which the North Star is producing most of its ores.

Indian Creek Mining, operating quartz claims near Esmeraldo, Calaveras County, has a crew of four men at work, and one tunnel is in 700 ft. An air compressor and drills have been installed. Ore is being taken out and piled on the dumps preparatory to the installation of milling machinery.

Alleghany-El Dorado Mining, which recently took over the Yellow Jacket mine, adjoining its properties in Nevada County, has been operating steadily. It has been found, however, that a cyanide plant may have to be installed to treat the ore.

The new mill installed at the Red Cross mine, Yuba County, is operating successfully, according to Walter Techow, mining engineer of Sacramento. The mine is owned by a Honolulu company.

Nine Killed by Fire at Allenby

FIRE destroyed the new bunk house of Granby Consolidated at Allenby, B. C., on March 18, killing nine men and injuring several. The building was completely demolished, with a loss of several thousand dollars.

The blaze started at 4 o'clock in the morning, when the bunk house was filled with the men of the day shift. The cause is as yet undetermined. The fire will not affect production from the mine, known as the Copper Mountain branch. It is one of the two large producing mines owned by Granby, the other being the Hidden Creek property.

Canadian Gypsum Companies Are Merged

Canadian Gypsum & Alabastine and Manitoba Gypsum Company, Ltd., two of the largest producers of gypsum in Canada, have been merged recently. The Manitoba company controlled the British Columbia Gypsum Company, which owns high-grade deposits at Falkland, B. C., and a gypsum products plant at Port Mann, B. C. The transaction is said to involve about $3,000,000. The combined company owns deposits in Nova Scotia, New Brunswick, Ontario, Manitoba, and British Columbia. Use of gypsum for building materials has grown very greatly in Canada.

North Bunker Hill Resumes Development Work

NORTH Bunker Hill Mining recently resumed work on its properties at Wardner, Shoshone County, Idaho. Herman Sundquist and E. H. Baker will be in charge of the underground work. At present this consists mainly of carrying the crosscut on the Drum tunnel level forward to cut the vein exposed on the intermediate level above. This work is being done on the recommendation of a geologist who has traced out the vein system in the North Bunker Hill ground. The ore is characteristic Coeur d'Alene silver-lead.

Bunker Hill & Sullivan has found an oreshoot of average grade on its 19 level that adds greatly to the company's ore reserves. The ore lies fully 4,000 ft. below the surface, levels at the Bunker Hill mine being 200 ft. apart. Estimates of the tonnage contained by the vein run as high as 5,000,000.

Yolande Mining recently purchased the property of the Tuscombia Mining Company on Beaver Creek, Idaho, for $100,000, payable in three years. The bond provides that work will start at once. Sidney Shonts, mining engineer of Wallace, will have charge of operations. Both this property and the adjoining Idora mine, owned by the same company, will be operated through one tunnel.

Development work at the property of Dickens Consolidated, on Moon Creek, in the Coeur d'Alene district, has disclosed a large oreshoot on the 500 level. No decision has been reached by the directors of this company as to the 200-ton mill which the company intends building this summer.

Colorado Mining Is Realizing Value of Modern Machinery

Electric Power Almost Universally Used in Cripple Creek District— Number of New Mills Planned

SOUTHERN COLORADO POWER, in a statement released recently, shows that, of the 30 active mines in the Cripple Creek district of Colorado, 29 are using electrical power in their operations. In many operations it has been found necessary to run several miles of pole line to reach mines in isolated districts. Inasmuch as Colorado mining for some years has been regarded as being rather a stagnant industry, this application of modern methods would imply a more progressive attitude on the part of small mine owners.

A number of mine owners are considering financing a large reduction mill to be located at Denver, Colo., according to reports received from that city. The Public Service Company of Colorado has signified its willingness to cooperate in providing power at reasonable cost. The mill will be used to treat ores which at present must be shipped outside the state.

The new mill of the Butterfly Consolidated Mines, at Ophir, Colo., is ready to start operations. The mill is of 100 tons' capacity. Table concentration and oil flotation will be used in treating the ore. Chief values are in silver and copper, with smaller amounts of gold, lead, and zinc.

The Metalloid Corporation, of Chicago, is to erect a grinding mill at Pueblo, Colo., for the preparation of such non-metallic minerals as mica, bentonite, feldspar, and quartz. Lack of milling facilities has retarded the growth of these minerals in the past.

Tomboy Mine Owner Sued by Leaser

George Oberto, part owner of the Tomboy mine, near Telluride, has been sued for $540,000 damages by F. W. Schuler of Pueblo, Colo. In the suit filed at the district court of Pueblo on March 3, Schuler claims that after he leased the mine Oberto deprived him of it. The Tomboy property was formerly owned by an English corporation, the Tomboy Gold Mines, Ltd. It was closed down early in 1927 because of a decrease in the average yield of the tonnage being mined, which made operations at a profit impossible. In May, 1927, Colorado men, headed by Oberto, acquired it for $30,000.

Gloria Mining Will Sink Shaft Deeper

Gloria Mining Association, which owns the Gloria mine near Glenrock, in Converse County, Wyo., has announced that it will sink its shaft down to 100 ft. At present, it is 40 ft. deep. The ore carries lead and a small quantity of gold.

Wyoming Gold & Copper is the name of a company that has been formed to take over the Gold Nugget and McGrath copper mines, which are situated in the Wild River Canyon, near Casper, Wyo.

Suit to Dispossess Eagle-Picher Lead Pending

Suit is pending in the United States court at Tulsa to dispossess the Eagle-Picher Lead Company of its mining leases on Quapaw Indian lands, on the ground that Secretary Fall failed to demand competitive bidding for the leases.

Correspondence which was presented by the Eagle-Picher Lead Company shows that competitive bidding was ordered.

House Mines Committee Passes New War Minerals Relief Bill—Secretary Work Opposes It

By Paul Wooton
Special Washington Correspondent

THE HOUSE of Representatives is urged by the Committee on Mines and Mining, in reporting on the Winter war minerals relief bill, to pass the measure so that the courts may review the claims. A minority report will be submitted, but had not been prepared at the time of this writing. The report of the majority, among other things, says:

"It is respectfully submitted that the right, just, and equitable method of forever settling these claims is to have the law interpreted by the court. If the claimants are right in their views as to the proper interpretation and construction then their claims should be adjudicated and paid. No one could reasonably object to such settlement and payment. If on the other hand the claimants are mistaken in their views as to the law and the intention of Congress in the passage of said acts then the United States government would not lose or pay out a dollar on these claims. It would seem that in all justice and fair dealing the claimants should have their day in court which is provided by this act.

"There are 396 claimants for losses suffered on the items of 'purchase of property and leases' and 'interest on borrowed capital.' There are 80 claims for less than $200 each, 45 from $200 to $500, 38 from $500 to $1,000, 34 from $1,000 to $1,500, 30 from $1,500 to $2,500, 68 from $2,500 to $5,000, 42 from $5,000 to $10,000, 37 from $10,000 to $25,000, 10 from $25,000 to $50,000, 12 in excess of $50,000."

Secretary Work is opposed to the bill. In a letter to the committee he called attention to the fact that the original act vested final authority in the Secretary of the Interior and specifically stated that no authority was given under which a suit could be brought against the United States in any court. He declared that the entire list of 1,268 claims has been investigated and disposed of, reviewed the history of war minerals relief legislation, and concluded by saying:

"When Congress passed the war minerals relief act the circumstances and events out of which the moral obligation to these claimants grew were fresh in the minds of its members. If Congress had felt the government was a debtor at law the losses undoubtedly would have been made recoverable in a court. Having declared otherwise, and all claims having been examined and disposed of in conformity to the act as passed, I cannot now approve a bill which is in direct opposition to the letter and spirit of that act."

Secretary Work also pointed out that the original law was an effort on the part of Congress to repay certain losses which it would have been under no legal obligations to make good. "Congress did not wish to create a legal claim," he continued, "It was not dealing with vested right. It did not make the losses recoverable in a court, but expressly provided otherwise. It dealt with the subject with the utmost caution. It hedged the granting of the equitable gratuity with limitations to prevent the use of the statute for the recovery of doubtful or fraudulent claims or merely speculative losses. It vested the secretary with power to reject all losses except as he was satisfied that they were just and equitable and it made his decision conclusive and final. Final against whom? Against the claimant. He could not resort to court to review the secretary's decision. This was expressly forbidden. By the proviso, however, the government was permitted, through any of its agencies or even by a committee of Congress duly authorized, to review the settlement by the secretary and by necessary implication to reverse it. If the government was defrauded, it was authorized to sue to recover any money paid under the award."

The program for the work of the Bureau of Mines on geophysical prospecting, which will go into effect at the beginning of the new fiscal year, is now being formulated. It is expected that an increasing amount of research can be done on that subject. More is being learned of the limitations of these methods and of the fields and the conditions in respect to which they are specially useful.

Some relaxation in the amount of geophysical prospecting being done in the oil fields of the south was interpreted at first as an indication that less reliance is being placed on geophysical methods. Inquiry has disclosed, however, that the lull was only temporary and that practically all areas are being gone over again with more refined methods.

Main Vein Being Drifted on at Ardsley Butte

The Highland mine of Ardsley Butte Mines is shipping large quantities of silver ore to the Timber Butte mill owned by the Clark interests. The main vein is being drifted on to the west and a winze is being sunk to the 550 level. The crosscut to the south is nearing the vein, which showed commercial ores on the 75 level. It is believed that the south vein will be encountered at a point within 100 ft. of the Highland vein.

Domestic Manganese Plant Starts Producing

THE new plant of the Domestic Manganese & Development Company at Butte, Mont., started producing on March 15. It is the largest manganese nodularizing works in the world. The plant equipment was described in *Engineering and Mining Journal* of Feb. 18. Ores will be drawn from the Emma mine of Anaconda Copper, the Travonia mine, owned by the Clark interests, and other properties in the Butte, Philipsburg, and Basin districts. These districts have sufficient ore already determined to supply the plant for an indefinite period.

Reserves of manganese ore in Montana have been estimated to run into millions of tons. The production of the plant is rated at 100,000 tons a year of nodulized ore, running 57 per cent metallic manganese. This is higher than any ores ever shipped from foreign countries.

Sterling Mine in Oregon Is to Be Reopened

F. J. Blakeley and associates of Portland are reopening the Sterling placer mine, on Sterling Creek, near Medford, Ore. The mine has been closed for the last sixteen years because of litigation. J. F. Mathews, for the past 25 years engaged in mining in Alaska, is the engineer in charge.

Another placer property near Medford which has been inactive for many years because of litigation has already been put on a producing basis. This is the Federal mine, located on Little Applegate River, 12 miles from Medford. A number of Seattle men reopened the property early this winter at an estimated expense of $25,000.

Ludlum Engineering Corporation has built a power line to the Foots Creek placers, 6 miles below Gold Hill, Ore. The company is assembling a 1,000-ton shipment of dredge equipment preparatory to laying the keel of an electrically driven dredge about May 1. The property of the corporation consists of about 1,000 acres of dredging ground.

Proposal Made for Railroad to Red Lake Field

A BILL has been introduced in the Ontario Legislature incorporating the E. W. Backus Company and authorizing them to construct and operate a railroad, 150 miles in length, between Kenora, Ont., and the Red Lake mining field, in the Patricia district. It stipulates that the road must be started within two years and completed within five. The approximate cost of the enterprise is estimated at about $8,000,000.

The Patricia district at present is entirely dependent on airplane service for rapid communication with the outside world.

A group of student-miners at the Alaska School

Alaska School of Mines Introduces Course in Practical Mining

DEAN PATTY of the Alaska School of Mines feels that too many graduates from mining schools lack the confidence to go into a mine; set up a machine; drill and blast a round; and put in a set of timbers. To meet this failing the Alaska School of Mines requires that its sophomore students take a two-credit laboratory course in practical mining. This class devotes six hours each week during the semester to this work. Last semester a group of six students drove 156 ft. of tunnel at a cost of $598.47, or $3.83 per foot. The students rotated as machine men, compressor man, and shift boss. Detailed cost accounts were kept, and these records will be used in a later course in mine cost keeping.

Various types of tunnel rounds and methods of blasting were tried out in actual practice. All drilling, blasting, track laying, piping, and necessary timbering were done by the students. The mucking was done under contract at $1.50 per foot of tunnel advance. This was the only labor paid for.

The experiment was so successful that it will be continued next year. The tunnel when completed will be used by the college as a passageway for power and water lines. The work was under the direct charge of J. C. Scoles, associate professor of mining engineering.

The college recently received, as a gift, the library of the late Dr. Alfred H. Brooks, for many years chief of the Geological Survey in Alaska. The library contains approximately 2,250 bound volumes and about 4,500 pamphlets and bulletins. A large number of the publications are technical in nature. There is a fine selection of books on Alaska, some of which are now very difficult to obtain. The gift is accepted with the understanding that it will be kept intact in the library of the college, separately indexed, and known as the Dr. Alfred H. Brooks Library.

New Quincy Mine Strikes Bedded Deposit

A bedded deposit struck in the New Quincy mine at Park City, Utah, adjoining the Daly West property of Park Utah Consolidated Mines, gives rise to the hope that another productive mine may be opened up in Utah. According to the latest report received from Andrew J. Hurley, manager of the mine, the deposit has been drifted on for 20 ft. and crosscut 25 ft. in solid ore. Drilling indicates that the orebody is 10 ft. thick. The ore carries values in silver, lead, gold, and copper.

When the embryo engineer wields a pick

Calumet & Hecla Developing Keweenaw Options Thoroughly

Cliff No. 4 Shaft to Be Used as Base of Operations After Dewatering Is Completed

CALUMET & HECLA Consolidated's exploratory project in Keweenaw County, for many years a neglected section of the Michigan copper district save for a few scattered openings, will be the most extensive and important ever attempted in that region. Keweenaw County has never before been explored in the logical, thorough way at depth. Upon the results depends the future of Keweenaw as a copper-producing district.

Explorations at the start will be conducted at a depth of 1,600 ft., representing the depth of No. 4 shaft of the Old Cliff mine, which will be used as the base of operations. This work will get under way soon, with completion of dewatering. Later, explorations will be carried out with the old Phoenix mine as a base and possibly from other points.

From the bottom of Cliff No. 4 shaft, drifting will proceed for several hundred feet on the most favorable lode. Extensive crosscutting then will be done for examination of the veins traversing Keweenaw. There is no positive assurance of discovering new copper deposits, but the project is attractive from a geological standpoint. A study of geological conditions as dewatering operations have proceeded in No. 4 shaft has strengthened the theories upon which the program was based.

In addition to its own lands and those of Cliff Mining, Calumet & Hecla has an extensive tract under option, having recently increased its optioned holdings by more than 1,000 acres. This gives it an unbroken stretch of territory through almost the entire length and breadth of the Keweenaw area, permitting uninterrupted investigation. The work will be done at a depth at which the formation should be settled and more uniform in copper content.

New openings in Isle Royale's two operating shafts show a continuance of the good ore which has characterized operations in this mine during the last few years. This is particularly true in No. 5, in which 78 per cent of ground opened last year shows copper content of the average of the mine. Recovery of refined copper per ton is 24½ lb. In No. 4 the percentage of stoping ground is 61. Each of these shafts is 4,000 ft. deep. This is comparatively shallow for mines in the Michigan copper district, which, with persistency of copper occurrence, indicates a long life for this property. Production is a little short of 1,000,000 lb., refined, per month, the largest output in the history of the mine.

Copper shipments out of the Michigan district are brisk, close to 500,000 lb. going forward daily. Most of the metal is moving to mid-West points. Business has been good since the first of this month, following a lull in February which made that month the lightest in shipments for a year.

The fissure vein in Ahmeek's No. 2 shaft, which has been a rich source of copper at this Calumet & Hecla property, has made its appearance at depth in No. 3 shaft and is being mined at the 33 level, yielding about 60 tons a month. The vein is about exhausted in No. 2. This shaft now is bottomed at the 37 level.

February was the best month in Mohawk's history in point of production, output being considerably in excess of 2,000,000 lb., refined. The continued richness of No. 6 shaft largely accounts for the continued good showing of the Mohawk mine.

Work Resumed at Belmont Mine of Anaconda Copper

According to an announcement made by W. B. Daly, general manager of mines for Anaconda Copper, the Belmont mine of that company has resumed operations. The mine has been shut down since last October, when a fire made shaft retimbering necessary. The fire in the Badger State mine, which recently caused the death of three men, is now under control.

Industrial Conflict Is Chief Obstacle to Prosperity of Australian Mining Industry

Production of Copper and Gold Has Decreased in the Last Five Years and Conditions in Other Metals, Though Better, Are Not Satisfactory

By Walter J. Morley
Special Correspondent

IT IS POSSIBLE that to the outsider the Australian mining industry appears to be in a worse condition than it really is. As a matter of fact, during the five years ended 1926 (figures for 1927 have not yet been released) the value of all minerals produced in Australia increased from about £20,000,000 to £24,000,000, and 1926 showed an increase of more than half a million pounds over the record for 1925. Conditions in the individual minerals differ greatly. During the same period of five years gold production, for instance, declined nearly £2,000,000 in value. Copper decreased from £1,346,000 to £560,000. Decline in copper production, however, is not confined to this single period. Ten years ago the value of the annual copper production of Queensland alone was over £2,000,000. These two metals present the most difficult problems to the Australian miner. But it may be also noted that, though there has been an increase in total mineral production, this increase has not been nearly what it should have been, considering the mineral resources of the country.

The auriferous deposits appear to be almost exhausted. In copper, the situation is different. Large orebodies are known to exist—most of them of low and medium grade—which still remain unexploited. These cannot be profitably operated under existing conditions, however. At present but one company is concerned in the copper industry in all Australia—Mount Lyell, in Tasmania, able, with efficient management, to continue producing. It has cheap electric power and has restricted operation to higher-grade ores. However, even Mount Lyell can be none too sure of its future.

Silver and lead production in Australia has increased in value from £1,600,000 in 1921 to nearly £5,000,000 in 1926; but the 1927 production has been considerably reduced on account of the closing down of several of the Broken Hill mines. The Australian tin yield has nearly doubled in value in five years, and the increase has been steady throughout the period, notwithstanding that the high prices recently prevalent for this metal were not reached until about 1924.

The chief factor, in my opinion, holding back the mining industry in Australia, is the existing industrial condition, the outcome of so-called "labor" legislation and administration. In response to the ever-increasing demands of labor, the industrial arbitration courts established by that legislation have raised wages, reduced working hours, and granted improvements in already good working conditions to such an extent that industrial enterprise is being choked, capital has been prevented from investing, and profitable competition with outside markets is becoming impossible. These conditions affect the mining industry not only directly but also indirectly, by increasing railway and shipping freights and the cost of machinery, appliances, and general supplies. Moreover, the union men accept only those provisions of industrial court awards which suit them, whereas the employers rigidly observe them all, and there is no power to compel the former to accept these decisions.

A commonwealth tariff board, which recently, after taking evidence in all the states affected, refused a request for a government bonus on copper produced in Australia, said that this request was "tantamount to asking assistance to enable the mining industry, especially small mines, to produce copper by methods which must be regarded as uneconomic, if not obsolete." But, in my opinion, the reason why these methods remain as they are is because capital cannot be found to improve them, and capital is not forthcoming, either for this purpose or for new mining ventures, because of the existing industrial condition.

More Australian capital is invested in tin mining in Malaya than in Australia, although the island continent possesses many unexploited tin-bearing areas that could, if the cost of production were not so high as the result of labor conditions, be worked profitably at the present prices for the metal.

Though some improvement has been made in ore-treatment methods at Broken Hill, generally speaking Australian methods are not up to date.

The most urgent need of the Australian commonwealth is saner government "of the people, by the people, for the people"—government, both federal and state, that will legislate for all classes and not for one alone. We already have a federal government that is opposed to inordinate labor domination and demands, but it is fettered by the limits of the constitution, and cannot interfere in industrial troubles unless more than one state is involved. There are indications that the extremists, who have had their own way so long, have reached the end of their tether, and that a change in the direction of better government and wiser counsel, backed by public opinion, is about to take place, if, indeed, it has not already begun.

Ontario Legislature Considers Bills Designed to Stamp Out Fraud

THAT the Ontario government is sincere in its efforts to stamp out fraudulent stock promotions and high-pressure methods of selling is indicated by the fraud legislation which is now before the House. The government does not intend to scrutinize or pass upon new promotions before they are offered to the public, but is providing legislation which will enable the proper authorities to take quick action when complaints are made and which will enable them to have some control over the stock salesmen. The law provides for the registration of brokers and salesmen, with wide powers to the Attorney General to investigate and with penalties that will enable the act to be enforced.

All persons who may sell securities, whether they act as officials or salesmen of companies, are included in the act. Every broker must file a bond of $500 and all brokers and salesmen must be registered. The registrar shall keep a book with the name and address of every broker and salesman entitled to do business in the province. He may refuse registration within a ten-day period after application if directed by the Attorney General to do so. He may also, at the direction of the Attorney General, demand a substantial bond of a surety company as a condition precedent to doing business. This is intended to cover the case of foreign brokers and salesmen and others who may not be reputable, but who may be given a chance to do business under proper bonding.

Furthermore, the Attorney General may hold investigations and is given power to take such evidence and get such information as may be desirable, and he may apply to the Supreme Court of Ontario for injunctions, as conditions warrant. The Supreme Court may enjoin any broker or salesman from trading in securities if it is found that he has been acting in a fraudulent manner. The registrar may ask every brokerage firm selling securities to file with him a statement of the securities being sold and what the concern is representing to the public. If a different representation is made to the public, it will be evidence of a fraudulent act.

The Attorney General may also, where any person or company is under investigation, direct that any funds or securities of the person or company shall be held in trust by any receiver or liquidator who may be appointed. A contravention of any of the provisions of the act is subject to a fine of $1,000 for the first offence and $2,000 for a second or subsequent offence. Quebec is following Ontario's lead in this matter and an act is now before the Quebec House requiring the licensing of stock and bond salesmen similar to the one described above.

London Letter

By W. A. Doman
Special Correspondent

Anglo-Oriental Takes Lead in Consolidations of Tin Producers

London, March 6, 1928.—It is now officially announced that the Anglo-Oriental Corporation has turned down both the Kagera and Ankole options. Kagera Tinfields, a Uganda property, was considered particularly promising. The announcement of the refusal to take advantage of the options comes several weeks before their expiration. The matter is the subject of a good deal of comment, and I understand the people behind Kagera and Ankole are of the opinion that the ground has not been tested thoroughly. Tin ore has been mined in Uganda for some years, and some people hold the view that large quantities will still be produced. Most of the Uganda ore has been exported to Belgium in the past.

Apart from this incident, the feature of the week is the amalgamation of several tin-mining companies in Nigeria, the moving spirit being the Anglo-Oriental Corporation, Ltd. John Howeson, formerly a jute merchant of Calcutta, is at the back of this corporation, and has a vast scheme in mind. He aspires, so I am told, to control the tin deposits of the world, though no one believes he will be successful. He is certainly going to work in a clever way. Shares of the Associated Tin Mines, through the agency of which he is doing the consolidating, stand at a high premium, and by giving these shares in exchange for those of the companies to be acquired, he is substantially reducing the nominal capitals.

NOTHING is heard now of a tin famine. In fact, the suggestion is rather laughed at. It is said that Mr. Howeson has already ordered fifteen large dredges from an American firm, and is about to place an order for fifteen others. As these will be of the latest design and of large capacity, increased production is foreseen. One fact emerges from this—so say experts: the price of tin cannot be maintained at its present level with increased production. By acquiring many Nigerian companies, Anglo-Oriental will be the largest producer of tin in that country. How Mr. Howeson is to acquire control of the rest of the world's tin mines remains to be seen. It is admitted generally that though the Uganda tin fields may prove to be large, they will not be as rich as those of Nigeria.

Dr. W. S. McCann has made a geological report on the properties of Southern Rhodesia Base Metals, recently examined by P. K. Horner. He says in regard to the Copper Queen deposits that they are slightly enriched in the oxidized zone, but that there is no secondary sulphide enrichment. Dr. McCann does not believe that there is any reason to expect larger or richer orebodies than those that are exposed at present.

Some little surprise, not unaccompanied by criticism, was expressed when a circular was issued by the Mondego Tin Company of Spain, stating that the dredge had started work, but that as results did not come up to borehole samples, operations had ceased. The company was floated on reports made by the representative of the seller, and no independent investigation was made. This is now seen to be a mistake—as it should have been at the time. Sellers are not in the habit of decrying their wares.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Hudson Bay Mining to Spend $10,000,000 at Flin Flon for 3,000-Ton Plant

Toronto, March 17, 1928.—Hudson Bay Mining & Smelting, which owns the Flin Flon mine, is already working on plans for a 3,000-ton concentrator and a smelter of sufficient capacity to handle the product from the mill. Production from the mine is expected to start in 1930, and in the interval $10,000,000 will be spent on mining plant and smelter. Power development is now under consideration. No decision has as yet been made between the Island Falls power, in the Churchill River, and that from White Mud Falls, on the Nelson River. It is expected that the railway will be completed to a point where cement and structural steel can be carried to the mine some time this spring. The permanent roadbed should be completed by 1929, after which the line should be operating regularly.

Fifty tons of supplies are going to the Sherritt-Gordon property every day, and it is expected that everything will be on the property by the end of March. At present the transportation of freight is a big item. The company is using 153 teams, four Holt tractors, one Lynn tractor, and three Fordsons.

The Meyer property of Nipissing mines, one of the most famous of the old Cobalt producers, will be closed down within a few days. This property lies in the town of Cobalt, the ore being transported to the mill by aërial tram. The entire production will come from the properties lying on the west side of the lake hereafter.

J. E. HAMMELL announces the formation of the Northern Aërial Minerals Exploration, Ltd. The company will be what its name implies, an aërial prospecting corporation. Associated with Mr. Hammell is Captain Oakes, a veteran air pilot, who will have charge of the airplanes, of which several have already been purchased.

Mexico City Letter

By W. L. Vail
Special Correspondent

Decree Intended to Decrease Number of Suits Has Opposite Effect

Mexico City, March 8, 1928.—The recent decree ordering all litigants before the supreme court of Mexico to revive their activities within 30 days under penalty of having their cases automatically thrown out has resulted in the resuscitation of 90 per cent of the claims pending. This is precisely what the magistrates had not expected. They believed that such a decree would result in a reduction of the number of claims, many of which had not even been talked of for years. As it is, their work has been increased more than 200 per cent. Many important mining suits which were on the point of reaching a decision have been postponed indefinitely. The judges are now looking for some other solution to the problem.

Experts of the department of finance of the Mexican government are making a study of the desirability of removing the present restrictions on the export of gold from Mexico, with the possibility that the free export of gold may be decreed. A study of the situation is being made by the special commission that is endeavoring to rehabilitate silver. The discount of silver as against gold has been reduced during the eleven months that the special commission has been working on the problem from 12.2 per cent to 3.7 per cent. The policy of not coining silver will be continued till further notice.

VIOLENCE is again feared at the Piedra Bola mines, of the Amparo group in the State of Jalisco, and, at the request of the management, the federal government has sent troops to the mines. Trouble grew out of the discharge of a number of employees, the company alleging that paying ores are exhausted and that operations have been carried on for some time at a loss. The governor of the state has sent special representatives to the district in an effort to bring about a peaceful settlement of the difficulties.

The old mining camp of Guanajuato is jubilant over the recent strike at a depth of 1,180 ft. on the Peñoles properties. Diamond drilling shows a width of more than 20 ft. Several abandoned mining claims in the district are being prepared for development as a result. It is said that the Peñoles company has acquired controlling interests in practically all the claims near the new strike.

The Natividad mines in Oaxaca are working again after a shut down of several months, on account of labor troubles. The Peñoles company, which owns the mines, is doing considerable development work.

Societies, Addresses, Reports

Safety Association Makes Awards for Bravery

HEROISM and resourcefulness on the part of 15 American miners whose prompt action in the face of extreme peril resulted in the saving of the lives of a number of underground workers were recognized by the award of appropriate medals by the Joseph A. Holmes Safety Association on the occasion of the annual meeting of the officials of the association just held in Washington. Three gold medals, two silver, and ten bronze medals constituted the awards. At the same time the association, which is closely affiliated with the U. S. Bureau of Mines, awarded certificates of honor to seven mines and two quarries in recognition of especially meritorious mine-safety accomplishments. Particularly singled out for honor was the Stag Canon branch of the Phelps Dodge Corporation at Dawson, N. M. One section of the No. 6 mine of this branch has been in continuous operation for 20 months with only 3 minor accidents, totaling 10 lost days. What makes this record the more remarkable is that this particular section is devoted to the training of new or inexperienced employees in the principles of mining.

The Joseph A. Holmes Safety Association comprises in its membership a number of scientific and engineering societies, the U. S. Bureau of Mines, the American National Red Cross, and various mining organizations. It is named in memory of Dr. Joseph A. Holmes, first director of the Bureau.

Relief Map of Tennessee Aids Geological Study

A RELIEF map of Tennessee showing the relative elevation of different parts of the state has recently been published by the state division of geology, under the direction of Walter F. Pond, State Geologist. It brings out in a striking manner the extent to which the surface is a reflection of the underlying geology. The Great Smoky Mountains are seen to be held up by the very resistant crystalline rocks of that region. The ridges and valleys of the great valley of Tennessee are caused by the differential erosion by the rivers of hard and soft rocks which have been compressed into parallel waves by the Appalachian mountain-building forces from the southeast. Cumberland plateau is held up by resistant sandstones and gravel conglomerates and is undoubtedly a remnant of a plateau which once extended much farther to the east and west.

West Tennessee is much younger geologically, and represents a comparatively recently uplifted portion of the Mississippi Embayment of the Gulf of Mexico.

The map is distributed without charge, but 25c. in stamps should be sent to cover the cost of postage and packing. Address Walter F. Pond, State Geologist, Tennessee Geological Survey, Nashville, Tenn.

Lime Association to Try to Solve Industry's Problems

THE 1928 convention of the National Lime Association is to be held at the Belmont Hotel, in New York City, on May 23-24. The most emphatic note in the announcement is that this is to be a convention of the industry, rather than of the association, thus recognizing the sound principle that the industry must be given a time and place to discuss its critical condition. Last year it lost more than $3,000,000 and suffered a decrease of more than 200,000 tons in production.

There is to be no program for the convention, and no cut-and-dried plan will be offered. Members and others are submitting questions bearing directly upon conditions which prevail in various sections of the country, and these questions will serve as the basis of a round-table discussion. It is hoped this discussion will form some constructive plans to put the industry upon a sound basis.

Romance of "Transportation" to Be Discussed by Leaders in Its Recent Development

AT A MEETING arranged by the New York Alumni Association of Tau Beta Pi, co-operating with the New York section of the Founder Engineering Societies, four noted leaders in transportation by air and land will discuss "Transportation, Past, Present, and Future." Daniel Willard, president of the Baltimore & Ohio Railroad, and Major-General John F. O'Ryan, president of the Colonial Air Transport Company, Inc., and Colonial Western Airways, Inc., will discuss general aspects of their particular fields. Lieutenant-Commander Charles E. Rosendahl, U. S. N., will describe, with motion pictures, the landing of the great dirigible, the "Los Angeles," on the deck of the U. S. S. "Saratoga," and also tell about his recent trip to Panama. Edward Hungerford, director of the Baltimore & Ohio Centenary, recently held at Baltimore, will present a film, "The Fair of the Iron Horse," depicting the main events of the B. & O. centenary.

The meeting is to take place on March 29, 1928, in the main auditorium of the Engineering Societies Building, 29 West 39th St., New York City. Admission is free.

Research Fellowships Offered in Mining and Metallurgy

THE DEPARTMENT of mining and metallurgy, College of Engineering of the Carnegie Institute of Technology, is offering ten fellowships in mining and metallurgical research, in co-operation with the Pittsburgh Experiment Station of the U. S. Bureau of Mines and advisory boards representing these industries. Fellowships are open to the graduates of colleges, universities, and technical schools who are properly qualified to undertake research investigations. Each fellowship carries a stipend of $750, paid in ten monthly installments. Fellowship holders are required to register as graduate students and become candidates for the degree of Master of Science unless an equivalent degree has previously been earned. Fellows will not be required to pay registration fees. The purpose of these fellowships is the solution of problems which are of special importance to the mining, metallurgical, and allied industries.

All applicants for appointment to research fellowships should understand the following conditions governing the appointments:

Appointments to the position of research fellow are for a period of ten months, beginning Aug. 13, 1928. A major part of the time of the fellow may be devoted to assigned research in the experiment station of the Bureau.

School vacations will not be observed.

Any manuscript presenting the results of research will be published under the joint authorship of that member of the staff of the Bureau of Mines who directed the investigation, as the principal author, and the research fellow as the sub-author.

Fellows are not permitted to accept other employment for pay during the ten months' period of their appointment.

Application blanks will be furnished on request. Each applicant will be required to supply a copy of his collegiate record from the registrar's office of his college. Applications are due not later than May 1, 1928. All communications should be addressed to Prof. Edward Steidle, Secretary, Mining and Metallurgical Advisory Boards, Carnegie Institute of Technology, Pittsburgh, Pa.

Missouri School of Mines Has Record Registration

According to Noel Hubbard, alumni recorder of the school of mines and metallurgy of the University of Missouri, at Rolla, Mo., the registration at the school is now 504. This constitutes the largest number of students in the history of the school, and represents an increase of 13 per cent over the preceding season of 1926-27. The greatest increase was in the freshman class. The new course that the school is offering in ceramics is attracting a number of students. Registration in the course this year is double that of last year, the first year that it was offered.

Health Problems Studied by Bureau of Mines

AT THE Health Laboratory section of the Pittsburgh Experiment Station of the U. S. Bureau of Mines, a number of problems affecting the health of workers in the different mineral industries are being studied. The following outline of these investigations has just been made public:

The Bureau has been interested for a number of years in the effect on men of industrial dusts encountered in mining operations or factories. Data regarding a dust composed of but one mineral will give fundamental information. Hence, experimental work is being conducted on the effect of certain mineral dusts on animals.

Recently considerable attention has been directed to the question of stream pollution by acid mine waters. The Bureau of Mines is gathering data on this subject and attempting to devise feasible methods of preventing such pollution.

The Bureau is also gathering information concerning the effect on the composition of mine drainage of sealing abandoned mines and portions of mines so as to exclude air. Certain results indicate that this may result in a decrease in acid water in the overflow.

During the last three years the Pittsburgh Station of the Bureau has developed an instrument for recording extremely minute concentrations of carbon monoxide in air. Work on the improvement of this apparatus and the extension of its usefulness is still in progress.

In connection with many investigations conducted by the Bureau, especially field studies in coal mines, investigations after explosions or fires, and places thought to contain harmful gas, gas samples are collected. These are analyzed and the results interpreted in the light of experience.

It is frequently necessary to make pathological studies in connection with other problems. Such work includes toxicity data and pathological changes under various conditions.

Routine tests of gas masks and dust respirators are made. As new or improved masks and respirators come on the market, it is desirable to test them for safety and efficiency.

Men doing mine rescue work are compelled to breathe high oxygen concentrations over long periods of time. To determine the effect of such exposure, animals were confined in atmospheres of 95 to 98 per cent oxygen under various conditions for various intervals of time and the effects noted.

A study is being made of the pathology of carbon monoxide poisoning. The Bureau has been a pioneer in studying carbon monoxide and the emergency treatment for such poisoning. However, up to the present time there is but little knowledge of the pathological changes attending it. Such information will assist in developing better treatment.

Information regarding the physiological reactions attending periods of work at high temperatures and humidity, together with such work followed by rest periods under temperature conditions more favorable to comfort, is being obtained. The relation between the heat generated by the body, evaporation and comfort is also being studied.

Wire screens of various compositions are being exposed to atmospheric conditions over long periods. To correlate the resulting corrosion with atmospheric composition, the sulphur dioxide content of the air is being determined daily.

A.A.E. to Hold Annual Meeting in El Paso

THE American Association of Engineers will hold its fourteenth annual convention in El Paso, Tex., this year. The date for the convention has been set for June 4, 5 and 6. Mr. L. M. Lawson is chairman of the local committee. The headquarters of the convention will be in the Hotel Hussman.

University of Utah to Study Geophysics

THE UNIVERSITY of Utah department of mining and metallurgy will begin immediately the study of problems connected with geophysics. This announcement followed the course of lectures given in Salt Lake on geophysics by Dr. C. A. Heiland, of the Colorado School of Mines, and J. J. Jakosky, consulting engineer of the Radiore Company, under the auspices of the department and the Utah Society of Engineers.

Research will center around accumulation of data regarding electrical phenomena observed in various types of mineralized deposits, in the hope that such research may facilitate the interpretation of results obtained in geophysical prospecting. At present electrical prospecting as well as other geophysical methods will only indicate the presence of an orebody without giving any clew as to its value, it is said. It is in this latter direction that the department officials will particularly turn their efforts.

Eastern B. C. Chamber Elects Officers

At the annual meeting of the Chamber of Mines of Eastern British Columbia, held recently in Nelson, B. C., the following officers were elected: E. W. Widdowson, president; R. H. Hunter and R. G. Joy, vice-presidents; Dr. H. B. Morrison, treasurer; H. E. Dill, auditor. Both Mr. Widdowson and Dr. Morrison expressed the opinion that the Kootenay district would be unusually active this year.

Research Fellows to Be Appointed at Wisconsin

TWO RESEARCH fellowships in engineering are to be appointed on April 30 by the University of Wisconsin, according to an announcement recently made by the university. Candidates for the fellowships must be graduates of engineering colleges of recognized standing, and, preferably, should have had one or two years of graduate study, of teaching, or of engineering experience. Applications will be received up to April 15. Information and application blanks can be obtained from Dean F. E. Turneaure, College of Engineering, Madison, Wis.

Appointments will be for a period of two years, subject to satisfactory service, and the salary will be $900 for the first year and $1,100 for the second. Not less than half time is to be devoted to research in the College of Engineering, but a fellow will be given an opportunity to complete the requirements for a master's degree within the two-year period. The period of service will be the usual academic year, including short vacations.

Colorado School of Mines Stresses Practical Training

Belief in the value of actual contact with mine conditions has led the Colorado School of Mines to devote the entire month of March to visiting mines, oil fields, and steel mills in various Western states. Four separate trips and itineraries were made out, each one emphasizing a different aspect of mining engineering. These trips were made under the charge of the professors at the head of the particular branch of engineering with which the trip dealt. Cost accounting and practical operations are being studied.

National Materials Handling Meeting to Be Held in April

The National Materials Handling Meeting, held under the auspices of the American Society of Mechanical Engineers, will take place in Philadelphia on April 23 and 24. The A.I.M.E., the National Coal Association, and the Philadelphia Engineers' club are cooperating in the meeting. Among the numerous technical sessions will be one on Mine Mechanization. The hotel headquarters of the meeting will be at the Benjamin Franklin. Reservations should be made directly with the hotel.

Refractories Institute to Hold Annual Meeting

The American Refractories Institute will hold its annual meeting on May 8 and 9. The committee in charge of arrangements has selected White Sulphur Springs, W. Va., for the convention.

Book Reviews

ALLUVIAL PROSPECTING: The Technical Investigation of Economic Alluvial Minerals. By C. Raeburn and H. B. Milner. Contains 478 pages and 171 illustrations. Thomas Murby & Co., London; D. Van Nostrand Co., New York, 1927. Price $14.

NOT so long ago, in a foreign country, the pitting and drilling of and assay of samples from an extensive alluvial or placer deposit yielded an average of about 40s. (say $10) gold per cubic yard. This high value aroused suspicion as to the methods employed, and a check gave less than one-twentieth of this value; whereupon the property was abandoned. If those engaged in the examination had possessed a copy of this new book, or any general work covering placer deposits, they might not have erred so. This by way of a general statement.

Several questions arise on scanning this book the first time: The first author is with the Geological Survey of Nigeria, west-central Africa, and the second author is lecturer in the Imperial College of Science and Technology, London. Naturally, their experience and views mainly cover British countries and those in which British capital is interested, but admittedly of general interest. Brief reference is made to certain alluvial deposits in North America; but if this book is to interest American engineers, and sell here, it should have more extended reference thereto. It would have been easy to engage an American engineer to contribute a short section on deposits and methods. Another question that arises from this book is, as mineralogy constitutes about half of the contents, would it not have been better to have restricted the volume to the subtitle—"The Technical Investigation of Economic Alluvial Minerals"—as it deals with all minerals found in placers?

Further perusal of this book reveals these features:

1. It is not for the lay prospector; it is more or less for the prospector who has had some scientific training; but the work is really for the examining engineer. For him is given a suitable and complete field outfit.

2. In the 44-page chapter on classification of alluvial and allied deposits are given a number of definitions, descriptions, and sketches of world-wide occurrences of various types of deposits and how formed.

3. A brief though interesting chapter covers the lithology or study of the rocks of alluvial deposits.

4. In deciding that Chapter III, "The Provenance and Association of Alluvial Minerals," is well discussed and of practical value, it may be asked why the word "provenance" is used instead of the common term "origin"? (Assemblages of or specific minerals indicate "parent-rocks" or the "provenance of minerals.") The essential and accessory rock-forming minerals and their "destabilization" (residual) products, the chief accessory minerals of various igneous and metamorphic rocks, and the "index-suites" of economic minerals are listed in such form they may be taken as a working guide in searching for the source of alluvial minerals. An example is given of tracing various minerals from an assumed distributive province. On page 75 of this chapter is a curious use of the words "sacrosanct" and "consanguineous."

5. It will be agreed that the mechanics of the medium of conveyance (water or wind) and accumulation of alluvium and aeolian placers is of importance, and in this book 39 pages are devoted to the factors involved.

6. Prospecting methods, with reference in a general way to particular mining methods which might be applicable to the diverse types of alluvial deposits, are described in 53 pages. The pan, rocker for gold or gemstones, long tom and sluice box, and drilling and pitting receive due attention; also the methods of calculation.

7. Years ago, when geophysical methods were mentioned in a casual way, it was predicted that they might be the means of discovering buried placers. The authors devote ten pages to the possibilities, but feel that, in general, geophysical prospecting methods "are not suited to the examination of shallow alluvials where drill holes or pits will afford more detailed and definite information. Nevertheless, a few of these methods are adapted to the location of buried alluvial systems, where topography gives no clue to their presence, and even, to some slight extent, to their evaluation."

8. Next comes a 26-page chapter on the field examination of concentrates; and after a few pages on the report, a 224-page section on the laboratory investigation of alluvial minerals. The field examination includes the luster, color, hardness, and specific gravity. Eight tables list the black, metallic luster, colorless or white, blue, red, brown, yellow, and green minerals, with their hardness and specific gravity. The laboratory investigation is divided into two chapters—technique and diagnosis. These are of considerable value, and, as already stated, they are a book in themselves—perhaps with that on field examination.

The laboratory technique consists of grading, isolation of species, crystallographic measurement, microscopic and physical tests, microchemical and chemical tests, blowpipe tests, and spectroscopic, radioactivity, and X-ray tests. (Magnetic, electrochemical, and photochemical tests, such as described in *Economic Geology* for November, 1927, by H. E. McKinstry, are not given.) The laboratory diagnosis includes the chemical composition, crystal form, habit, fracture, hardness, specific gravity, luster, color, streak, magnetic properties, electrical properties, chemical properties, and association. In this chapter are 27 plates showing mineral specimens, in general well reproduced.

9. A short glossary of terms, a good bibliography, and a good index complete a useful effort along original lines.

M. W. VON BERNEWITZ.

FLOTATION FUNDAMENTALS, Part 1. Technical Paper No. 1. By A. M. Gaudin, Harvey Glover, M. S. Hansen, and C. W. Orr. Published by the University of Utah in co-operation with the U. S. Bureau of Mines. Pp. 101. Figures, 82. Price 75c.

THIS publication contains data additional to those obtained in previous work with pure minerals begun several years ago by the Department of Mining and Metallurgical Research of the University of Utah in co-operation with the U. S. Bureau of Mines. In the experimental investigations covered by the paper about 5,000 separate tests were completed, and an attempt was made to avoid the objectionable features of the older technique. To this end, the minerals investigated were sized and the reagents added in solution.

Five studies comprise the paper: "Galena," by A. M. Gaudin; "Pyrite," by C. W. Orr; "Differential Flotation of Synthetic Mixtures of Galena and Sphalerite, and Galena and Pyrite," by A. M. Gaudin and C. W. Orr; "Flotation of Carbonate Minerals by Fatty Acids as Affected by Soluble Salts," by Mahlin S. Hansen; and "Flotation of Some Oxide and Silicate Minerals," by Harvey Glover.

In the study of galena, terpineol was used as a frothing agent, and the effects of specific chemical compounds as collecting agents were determined. The collecting agents used included fatty acids, alkyl xanthates, trithiocarbonates, aryl xanthates, monothiocarbonates, and carbothialdines. Other tests dealt with the combined action of frothing and collecting agents, relation of amount of collecting agent to surface developed in the crushed material, effect of alkalinity or acidity of circuit, and effects of cations and anions.

Tests with pyrite showed that when potassium ethyl xanthate is used as a collector, strictly pure pyrite is the most flotable of the sulphides of iron, lead, and zinc. Results obtained indicated that similar studies should be performed on other sulphides, particularly those of copper, and comparisons made in order to arrive at conclusions that may have practical applications.

In the course of the differential flotation of synthetic mixtures of galena sphalerite, and galena and pyrite, it was found possible to cause either one of the sulphides to float by suitably selecting the depressing agent (and in the cases involving sphalerite, the use of a suitable amount of modifying agent). A new metallurgical yardstick was also developed—the coefficient of perfection of separation. This coefficient does not

involve the value of the minerals, and gives a true index of the perfection of separation.

Results obtained with the carbonate minerals showed that all such minerals can be made to float, that differential flotation of one carbonate from another may be possible in synthetic mixtures of these minerals, and that oxidized carbonate ores can be concentrated by flotation by the use of suitably selected fatty acids as collecting reagents.

Experiments with quartz, cassiterite, specular hematite, and feldspar indicated that there is a possibility of separating feldspar from associated silica by flotation, and that cassiterite may be separated from quartz in synthetic mixtures by the use of some of the saturated fatty acids. This method, or a modification of it, according to the author, may have some practical application.

The paper, though dealing entirely with fundamentals, such as the floatability of pure minerals and synthetic mixtures of pure minerals under standardized conditions, is a notable record of flotation research. It indicates several channels for further investigation that should lead to new applications of the flotation processes, and it justifies clearly the advisability of research work to build up fundamental flotation data concerning the various minerals.

H. D. KEISER.

"THE GOLD OF THE RAND." Transvaal Chamber of Mines, Box 1162, Johannesburg, South Africa. 160 pages. Free distribution.

A BRIEF ACCOUNT of the Witwatersrand mining industry, its achievements and objects, with a description of the operation of the mines and their significance to the country, is given in this brochure, which is issued by the Transvaal Chamber. The information contained is that available on Nov. 30, 1927. The bulletin describes briefly the method adopted for working the deposits and the essential features relating to capital, labor, expenditure, taxation, and dividends, and shows how the Union of South Africa is dependent upon the satisfactory and economic workings of these mines, which have produced to date approximately £915,000,000.

LIGHT METALS AND ALLOYS—ALUMINUM AND MAGNESIUM. Bureau of Standards Circular No. 346. Pp. 410 Price $1.10. Sold by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

A REVISION of a "circular" issued in 1919. Since then such great progress has been made in the metallurgy of aluminum and light alloys, both from the practical and scientific aspects, that the first edition has become inadequate. This new edition has therefore been prepared to supply the need for a further comprehensive compilation of the physical properties of the metal and its alloys. A section on silicon and beryllium is included.

The information forming the basis for this compilation includes the data resulting from systematic research by the McCook Field Station of the U. S. Army Air Corps, by the Naval Aircraft Factory, by the U. S. Bureau of Mines, by the research staff of the Aluminum Company of America, and by the National Physical Laboratory of England, as well as by individual investigators in this and other countries. The new edition has been compiled by Miss M. G. Lorentz, with the aid of others in the Bureau of Standards.

OHIO GEOLOGY.—The Geology of Vinton County is the title of Bulletin 31 of the Geological Survey of Ohio, Columbus, Ohio. This bulletin is a volume of 400 pages. It covers the main stratigraphic features and gives detailed information about the valuable deposits of clay, coal, limestone, shale, and iron ore, as well as the oil and gas sands. Special attention is given to the clay deposits in Brown Township, which have unusual value. Price $1.

WESTERN AUSTRALIA—The most ambitious report received from any mining bureau in a long time is that of the Department of Mines of Western Australia for the year 1926. It comprises 435 8½x13-in. pages, including numerous inserted maps. It is a remarkable compilation of data, interesting and also uninteresting.

AERIAL SURVEYING — Bulletin 788-F of the U. S. Geological Survey covers the subject of "Map Compilation from Aerial Photographs. The author is T. P. Pendleton. The bulletin covers 40 pages and is sold at 15c. per copy by the Superintendent of Documents, Government Printing Office, Washington, D. C.

COLORADO GEOLOGY — The Progress Report on the Co-operative Geological Survey in Colorado for 1926 and 1927, which was presented at the joint meeting of the Colorado Mining Association and the Colorado Chapter of the American Mining Congress on Jan. 20 last, has been issued in pamphlet form. It covers 18 pages.

ZINC—The March 1 issue of *Mining Truth* contains some photographs of the new electrolytic zinc plant being built at Kellogg, Idaho, by the Sullivan Mining Company. The same issue contains an article on the plant erected at the East Helena smelter, in Montana, to treat its slag dump.

ZINC — The *Canadian Mining and Metallurgical Bulletin* for March contains an article entitled "Mining and Milling at the Tetreault Mine," by the staff of the British Metal Corporation. This mine, it is stated, is the only steady producer of zinc in Canada east of the Rocky Mountains. In 1927 it was responsible for over 13 per cent of the zinc output of the Dominion.

INTERNAL COMBUSTION ENGINES — The March *Bulletin* mentioned in the preceding paragraph also contains a 30-page article entitled "Internal Combustion Engines for Mining Purposes," by F. A. McLean.

FIRE PREVENTION—The bulletin mentioned in the foregoing paragraphs also includes an unusual article on "Fire Prevention and Fire Insurance for Mine Buildings." The author is W. G. Millar, chief engineer for Irish & Maulson, Ltd. In view of the large number of fires annually occurring in the mining industry, more attention might well be devoted to this subject.

MINERAL STATISTICS — Two reports on Canadian mineral production have been received. One is Bulletin No. 64 of the Ontario Department of Mines, entitled "Preliminary Report on the Mineral Production of Ontario in 1927." The other is a similar preliminary statement on the mineral production in the Province of Quebec during 1927. The latter is issued by the Department of Colonization, Mines and Fisheries, Quebec.

GEOPHYSICS — A four-page bibliography of geophysical topics is given in an article by Dr. Weigelt, of Halle, Germany, that appears in a recent issue of *Metall und Erz.*

RED LAKE—The March 2 issue of the *Canadian Mining Journal* contains the first installment of an article on the Red Lake gold deposits, by E. L. Bruce and J. E. Hawley.

PATENTS

CRUSHER. No. 1,660,652. Feb. 28, 1928. Alfred Molander, St. Paul, Minn.

METALLURGY. No. 1,660,817. Feb. 28, 1928. George W. Prince and Joseph H. English, assignors to United Verde Extension Mining Company.

Apparatus and method of treating copper ores by agitation and leaching with sulphur dioxide gas; also for precipitating the copper electrolytically as fast as it is taken into solution.

COMPRESSOR. No. 1,661,148. Feb. 28, 1928. J. F. Winkler, Philadelphia.

MINE SUPPORT. No. 1,661,238. March 6, 1928. John Sloan, Johannesburg, South Africa.

A support for mine workings, including a skeleton metal cage for holding filling material.

OIL MINING. No. 1,661,389. March 6, 1928. E. G. Sinclair, assignor to the Midwest Refining Company.

A method of extracting oil from formation intersected by spaced galleries and connected crosscuts.

ZINC. No. 1,661,813. March 6, 1928. Henry J. Stehli, Cedar Grove, N. J.

A process for sintering zinc ores.

DRILL SUPPORT. No. 1,661,956. March 6, 1928. John Nagy, Jessup, Pa.

A pair of extensible props having lateral supporting arms adjacent to corresponding ends, with other features for supporting a rock drill underground.

Personal Notes

SYDNEY BARTLETT has left the Santa Gertrudis company and has gone to Bolivia.

M. J. CALLOW is returning to Salt Lake City after spending several months in New York.

ANDRES VILLAFANA has been appointed superintendent of the Natividad mines, in Oaxaca.

G. H. CLEVENGER left for Pachuca, Mexico, on March 18, expecting to be away about three weeks.

F. R. LYNCH, a director of the Anglo-American Corporation, has returned to Johannesburg after a visit to England.

GEORGE H. MILLER, of Pittsburgh, has been appointed head of the Mines Safety Service of the U. S. Bureau of Mines in Alaska.

SAM LEWISOHN, vice-president of the Miami Copper Company, sailed today aboard the Leviathan for a vacation in Spain.

CHARLES BOCKING, general manager for Granby Consolidated, is in New York. He has recovered from his recent illness.

C. T. VAN WINKLE, consulting mining engineer of Salt Lake City, recently returned to that city from a two weeks' trip to Mexico.

H. Y. EAGLE has gone to Tasmania, where he will supervise the starting of an electrolytic copper refining unit at the Mount Lyell mines.

RAYMOND BROOKS, formerly manager for Rhodesian Congo Border Concession, Ltd., has returned to Africa for a visit on professional business.

HEATH STEELE, vice-president of American Metal, is making his regular tour of Mexico to inspect the various operations of his company.

T. BRAY and C. COLLET, of Kimberley, B. C., are on their way to Nigeria to engage in exploration work for Consolidated Mining & Smelting.

F. E. SHEPARD, director of the Denver mint, recently addressed the Colorado Engineering Council on "Engineering Progress Through Research."

M. J. MULDOON, formerly superintendent of operations at the Nabob mine, has been appointed foreman at the Douglas mine in the Coeur d'Alene district.

CHARLES B. MORGAN, mining engineer, is in charge of exploration and development at Red Lake Gold Shore, in the Patricia district of northern Ontario.

H. H. HORTON, formerly assistant manager of the Moctezuma Copper Company at Nacozari, Sonora, Mexico, has been promoted to the post of general manager.

WILLIAM BURNS, recently reported as manager of N'Changa Copper Mines, Ltd., in Northern Rhodesia, is now also manager of Rhodesian Congo Border Concession, Ltd.

Prof. ROBERT PEELE is engaged in revising his "Compressed Air Plant," the last edition of which appeared in 1918. The new text will be ready, he expects, some time next year.

LEWIS BUCKLEY STILLWELL, of New York, has been re-elected chairman of the Engineering Foundation, the research organization of the national engineering societies. Mr. Stillwell, who enters his fourth term as chairman, was formerly president of the American Institute of Electrical Engineers and the American Institute of Consulting

LEWIS B. STILLWELL

Engineers. He is a native of Pennsylvania, a graduate of Lehigh University, and a life trustee of Princeton. Wesleyan University bestowed upon him the degree of Doctor of Science. ARTHUR D. LITTLE and GEORGE A. ORROK were re-elected vice-chairmen of the Foundation. ROBERT RIDGWAY of the American Society of Civil Engineers, and J. V. N. DORR of the A.I.M.E., were chosen additional members of the executive committee.

W. W. DAVIS, mining engineer, has been engaged by Clericy Consolidated to take charge of operations at its properties in the Sudbury base metals field of northern Ontario.

REGINALD E. HORE, geologist of Toronto, has been retained in a consulting capacity by the Natural Resources department of the Canadian National Railways.

MAJOR D. GILCHRIST has resigned as manager of Loangwa Concessions (Northern Rhodesia), Ltd., to become assistant manager of Rhodesian Congo Border Concession, Ltd.

RICHARD M. FIELD, professor of geology, is to conduct a tour of the Princeton summer school of geology through Western mining districts. The trip will start June 21.

M. K. CAMPBELL has been appointed general manager of the Bradbury interests at the Tajo mine, Rosario, State of Sinaloa, Mexico. Mr. Campbell was formerly mine superintendent at the property.

W. J. O'CONNOR, manager of the Utah operating department of American Smelting & Refining, recently was a visitor in Montana. Mr. O'Connor was manager of the East Helena plant of the company.

J. B. TYRELL, Toronto mining engineer, has been elected president of the Champlain Society, the only society in Canada which exists for the purpose of publishing rare or unprinted material relating to Canadian history.

J. D. MCKENZIE, manager of the New State Areas, on the Far East Rand, has been granted a leave of absence. R. S. THOMPSON, underground manager, will be acting general manager while Mr. McKenzie is on his vacation.

F. A. KELLY has been made district superintendent of the Cuyuna range properties of Pickands, Mather & Co. Mr. Kelly's position at the Dunwoody mine is to be filled by KENNETH DUNCAN, superintendent of the Zenith mine.

A. GROOTHOFF has been elected president of the board of the N. V. Hollandsche Mettalurgische Bedrijven. This company was formed for the purpose of erecting a smelter in Holland. KARL VOLKMANN has been appointed manager of the smelter.

BROUGHTON EDGE is in Australia, making geophysical surveys. Although Professor Edge's best results have been achieved in locating oil, he will first give his attention to the lost auriferous lodes of Western Australia. He is accompanied by Prof. NEIL LEWIS.

C. D. WOODWARD, chief engineer of Anaconda Copper at its Butte properties, recently addressed the Kiwanas Club, of Butte, on the electrical hoists installed last year at the Belmont mine. Mr. Woodward explained in detail how the change from steam to electrical hoisting was made in less than two days.

W. C. MANSFIELD, accompanied by W. P. POPENOE, left Washington on March 12 for work in the coastal plain of Virginia in co-operation with the State Geological Survey in preparing the geologic map of Virginia. Both Mr. Mansfield and Mr. Popenoe are members of the U. S. Geological Survey.

OBITUARY

HAROLD V. PEARCE, chemical engineer and smelter expert, son of the late Richard Pearce, died at Seaford, England, recently.

Market and Financial News

March Dividends Continue Strong

Betty O'Neal Mines and Eagle-Picher Lead Are Missing

DIVIDEND disbursements in March were somewhat less than in December, but considerably greater than in March, 1927, and virtually the same as in September. Eagle-Picher Lead passed its regular quarterly dividend, to contribute the only bearish tidings, of importance, in the report. The prevailing low prices of lead and zinc are reflected in the reported earnings of most of the producers in the lead-zinc fields of Missouri, Kansas, and Oklahoma, particularly those who have not been in position to effect material savings and economies in operating expenses.

New Jersey Zinc is missing from the March roll, but there should be no misapprehension on that score, as New Jersey's payments follow a bi-monthly, more closely than a quarterly, schedule. California Rand Silver reports a payment in March, but was not included in the December list, because it pays bi-monthly. Isle Royale Copper continued at its semi-annual rate, 50c. per share, established last year.

Among the smaller companies, Betty O'Neal Mines, the ambitious Nevada silver property, seems to have been forced from its place among the select, temporarily, following payments of 5c. per share in September and December of last year. However, the Flowery Mines Company, operating the Berry and Lady Bryan mines, in Six Mile Canyon, Nevada, announces its initial dividend, at the rate of 2c. per share. This payment is not included in the accompanying list, as no information is at hand regarding the number of shares of stock outstanding; and consequently the total amount paid is unknown. Mother Lode Coalition, Vanadium Corporation of America, Amparo Mining, and Nipissing are irregular dividend payers that do not appear this month. Mohawk Mining decreased, by one-half, its December payment, as did Keeley Silver Mines its semi-annual payment of September. Mond Nickel lists a disbursement on a par with the rate established in recent years.

National Lead is decidedly among those present All three classes of the Lead Company's stock contribute to the March totals. Inland Steel added an extra payment of 4¼c. per share to its regular disbursement. Tintic Standard decreased its extra quarterly payment from 20 to 10c., making the total paid in March 30c. per share. This appears as an increase when compared with the December payment, a condition that is readily explained, as the usual quarterly extra was augmented by a Christmas bonus, and the two appeared together soon after the first of the year, December being credited only with the regular quarterly payment. Reduction in its dividend rate has been caused by a decrease in the company's earnings, resulting from the continued low prices of lead and silver. Silver King Coalition declared its regular dividend, commonly issued in March, payable April 2, which results in another "book" loss for the month.

Widespread increase in the figures representing "per cent annual yield" is noted. This condition may be explained by the fact that many of the mining stocks have been adversely affected, on the stock exchanges, by the depression of the major non-ferrous metal prices, while continuing their usual dividend rates. This in part is the result of a healthy reaction from the extremely high levels reached in the share market recently.

Mining Dividends and Yields for March, 1928

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
American Metal	U. S. and Mex.	$0.75 Q	$446,127	7.5
American Metal, pfd.	U. S. and Mex.	1.75 Q	87,500	6.0
American Smelting & Refining, pfd.	U. S. and Mex.	1.75 Q	875,000	5.3
Bunker Hill & Sullivan, s, l	Idaho	0.75 M	245,250	6.0
Butte & Superior, z, s	Mont.	0.50 Q	145,099	19.1
California Rand, s	Calif.	0.01 BM	12,800	....
Calumet & Arizona Mining, c	Ariz.	1.50 Q	964,135	6.4
Calumet & Hecla Consolidated, c	Mich.	0.50 Q	1,002,751	9.4
Federal Mining & Smelting, pfd., s, l, z	Idaho, Okla.	1.75 Q	210,000	7.4
Golden Cycle Mining & Red., g	Colo.	0.04 Q	60,000	9.1
Hecla Mining, l, s	Idaho	0.25 Q	250,000	6.0
Homestake Mining, g	S. D.	0.50 M	125,580	8.5
Inland Steel	Minn.	0.6675 QX	789,518	5.0
Isle Royale, c	Mich.	0.50 SA	75,000	8.0
Mohawk Mining, c	Mich.	1.00 K	115,000	....
National Lead	U. S.	1.25 Q	387,289	3.9
National Lead, pfd. "A"	U. S.	1.75 Q	426,433	5.0
National Lead, pfd. "B"	U. S.	1.50 Q	375,000	5.3
Nevada Consolidated Copper	Nev., Ariz., N. M.	0.375 Q	1,315,959	7.6
Republic Iron & Steel	U. S.	1.00 Q	300,000	6.5
St. Joseph Lead, l, z	Mo., N. Y.	0.75 XX	1,462,821	7.5
Sloss-Sheffield Steel & Iron	Ala.	1.50 Q	150,000	4.6
Tennessee Copper & Chemical	Tenn.	0.125 Q	99,328	4.6
Texas Gulf Sulphur	Texas	1.00 Q	2,540,000	5.5
Tintic Standard, s, l, c	Utah	0.30 XXX	345,874	9.5
U. S. Steel	U. S.	1.75 Q	12,453,411	4.8
Utah Copper	Utah	1.50 Q	2,436,734	4.2
Companies in Other Countries				
Chile Copper	Chile	0.625 Q	2,744,528	6.1
Hollinger Consolidated Gold	Ont.	0.10 F	492,000	7.5
International Nickel, n, c	Ont.	0.50 Q	836,692	2.3
Keeley Silver Mines	Ont.	0.04 SA	80,000	7.8
Lake Shore, g	Ont.	0.20 X	200,000	3.0
Lucky Tiger-Combination, g, s	Sonora	0.07 MX	50,073	10.5
McIntyre-Porcupine, g	Ont.	0.25 Q	199,500	3.7
Mond Nickel, c, n	Ont.	1s. 6d	£67,500	....
Total			$32,299,402	

s, silver; l, lead; z, zinc; c, copper; g, gold; n, nickel; t, tin; Q, quarterly; QX, quarterly 62.5c. extra 4.25c. M, monthly; MX, monthly 5c., extra 2c.; BM, bi-monthly; F, every four weeks; SA, semi-annually; X, 10c. regular quarterly and 10c. extra; XX, 50c. regular quarterly and 25c. extra; XXX, quarterly 20c. extra 10c.

STATISTICAL NOTES

MOHAWK MINING COMPANY'S summary of results for 1927 shows an output of 22,124,840 lb. of refined copper, which was produced at a total cost of 7.969c. per pound. Yield of ore treated per ton was 29.116 lb., the highest in several years. Cost per ton of rock hoisted was $1.764 and per ton of ore stamped, $1.819. Tons of rock hoisted were 783,499, only 3 per cent of which was waste. Amount of mineral produced was 28,506,000 lb., and mass 3,642,000, a total of 32,148,000 lb., which yielded 68.821 per cent of refined copper. The year 1927 was the most profitable, with exception of the war period, in the history of the company. A total of 20,325,613 lb. of copper was sold at 13.3931c. Profit for the year, before providing for depreciation and depletion and income tax, was $1,129,679. Net profit after deducting $200,166 for depletion and depreciation and $64,581 reserve for income tax, was $864,931.

ARIZONA COMMERCIAL MINING COMPANY, operating in the Globe district, Arizona, records decreased earnings during 1927, largely because of the lower price of copper prevailing and a decrease in the grade of ore mined. During 1926 a total of 65,689, dry tons of ore, averaging 5.17 per cent copper, was extracted, which compares with 66,517 tons of 4.70 per cent ore in 1927. Total metal production in 1927 was: Copper, 2,753 tons; silver, 32,664 oz.; gold, 1,157 oz. The company found it advisable to decrease the amount of its regular semi-annual dividend paid in July, 1927, from 50c. to 25c. per share.

CALUMET & HECLA CONSOLIDATED reports net profits of $1,032,098 for the last quarter of 1927. This is equivalent to 51c. a share on 2,005,502 shares and compares with 67c. a share for the corresponding period in 1926. As computed from quarterly reports, net profits for the entire year of 1927 amount to $3,931,137, equivalent to $1.96 a share, against $2.44 a share in 1926. Earnings in 1927 were only 4c. a share below dividend requirements, in spite of the price of copper, which was below 14c. a pound for the greater part of the year.

(Statistical Notes—Continued)

RAND GOLD MINES show the following results of operations for the month of January. The mines are arranged in order of profits earned:

	Tons Milled	Revenue or Value £	Costs per Ton s.	d.	Estimated Profit £
Govt. Areas	198,500	384,369	16	4.3	227,603
New Modder	137,000	312,020	19	2.6	180,385
Crown Mines	200,000	283,673	21	2.6	71,537
Springs Mines	69,500	140,047	20	1.6	70,089
Modder Deep	44,200	99,785	15	5.0	65,674
New State Areas	75,000	130,118	20	5.7	54,631
Van Ryn Deep	61,000	107,478	19	4.5	49,167
Modder B	68,000	108,511	18	2.6	46,573
Sub Nigel	22,500	.....	39	5.2	45,631
Brakpan	81,000	127,714	20	4.9	45,077
Geduld	82,000	110,169	16	5.0	42,810
Langlaagte Est.	79,000	104,845	21	1.1	22,506
West Springs	50,700	72,255	20	0.6	21,433
Con. Main Reef	57,000	95,292	26	2.8	20,517
Randfontein	200,000	192,552	17	5.7	20,193
Modder East	59,000	79,781	20	9.8	18,361
Robinson Deep	68,000	.....	20	9.1	11,212

CALIFORNIA RAND SILVER COMPANY'S report for the period Jan. 1 to March 1, 1928, shows gross smelter returns of $47,248, with total expenditures of $58,298, including regular dividend payment of 1c. per share on 1,280,000 shares of stock. The company reports a surplus in treasury of $179,106 as of March 5, 1928. Operations at the company's milling plant were continuous, at a daily rate of 112 tons, for the period.

UNION MINIÈRE DU HAUT-KATANGA has authorized a bond issue of 500,000,000 francs, of which 350,000,000 will be issued immediately. This issue of 350,000,000 will enable the company to complete the program now being carried out, aiming at increase in productive capacity and to bring costs down to the minimum. The company's business is satisfactory.

World Production of Gold and Silver

The American Bureau of Metal Statistics has issued the following tabulation showing the world's production of gold and silver in 1926 and 1927 as closely as can be computed at this time. Some of the figures for 1927 are preliminary, but with the exception of those marked with an asterisk, which are conjectural, any changes are expected to be small.

World's Gold and Silver Production

(In Fine Ounces)

Country	Gold 1926	Gold 1927	Silver 1926	Silver 1927
United States	2,335,042	2,178,389	60,918,000	59,412,000
Canada	1,754,228	1,825,241	22,371,924	22,210,936
Mexico	772,661	718,000	98,291,000	103,138,000
Total North America	4,861,931	4,721,630	181,580,924	184,760,936
Central America and West Indies	87,075	*80,000	3,499,118	3,000,000
Bolivia	332	*300	5,839,000	5,407,000
Peru	93,556	*95,000	21,100,000	18,800,000
Other South America	433,593	*454,700	3,006,598	*3,000,000
Total South America	527,481	550,000	29,945,598	27,207,000
Europe	1,096,386	*1,200,000	11,470,328	*11,500,000
Oceania (Australia and New Zealand)	653,494	642,000	11,224,824	11,500,000
Japan	267,800	*270,000	4,479,366	4,550,000
India	383,970	386,252	5,124,962	6,030,000
Other Asia	459,398	*449,000	2,565,070	*2,590,000
Total Asia	1,111,168	1,105,252	12,169,398	13,170,000
Rhodesia	594,208	581,790	153,990	131,598
British South Africa	9,954,762	10,122,491	981,333	1,012,035
Other Africa	404,109	*402,000	103,273	*100,000
Total Africa	10,953,079	11,106,281	1,238,596	1,243,633
Total for world	19,290,614	19,405,163	251,128,786	252,381,569

International Nickel Earned $3.30 on Common Shares in 1927

NET EARNINGS of the International Nickel Company, operating nickel-copper mines and a smelter in the Sudbury district in Ontario, a refinery at Port Colborne, Ont., and a rolling mill at Huntington, W. Va., totaled $6,064,544 in 1927, compared with $5,556,267 in 1926 and $5,527,484 in 1925. After the payment of preferred dividends, the amount applicable to dividends on common stock was $3.30, compared with $3 in the preceding year. The distribution on the common stock was only $2 per share, a significant figure when it is pointed out that the shares recently have been traded in actively on the New York Stock Exchange at close to $100. The advance in the share market may be attributed to heavy speculative trading, possibly to a campaign on the part of Canadian interests to get control of the company away from stockholders in the United States, and to the potential profits that are expected to accrue from the operation of the enormous new copper-nickel orebodies that are being developed in the Frood mine.

The Creighton mine and the smelter at Copper Cliff, Ont., were operated without interruption during the year and low production costs were maintained. Results from diamond drilling on the company's Frood property, as announced last year, indicated high-grade ore at depths below 2,000 ft. At that time it was decided to sink the shaft to a depth of 3,000 ft. rather than 2,000 ft. as originally contemplated. With the exception of additional shaft sinking and certain modifications in smelter construction this important work is progressing as outlined in the last annual report. During the past year the shaft was sunk to a depth of 2,500 ft. and should bottom early in 1928. Crosscutting, raising and station construction will take several months, and the orebody may not be reached before the beginning of 1929. Hoisting equipment and compressors have been ordered, and a contract for additional hydro-electric power equipment has been awarded, work on the installation of which will start in the course of a few months.

Stopes will be opened and underground equipment placed in the mine coincident with the erection of the Frood surface plant and the building of smelter additions at Copper Cliff. It is estimated that both mine and smelter will be in operation in 1931.

Data obtained from diamond drilling confirm the conclusion that copper is associated with nickel in the Frood ore in such quantities that a large increase in copper output is assured. The amount of copper which may be mined depends largely on world consumption of nickel, of which there is evidence of a steady increase. It is known that the precious-metal contents of the Frood orebody is greater than that of the Creighton mine, but exact estimates cannot be made until the ore is crosscut and further developed.

The matter of erecting the company's own electrolytic copper refinery at Copper Cliff is receiving consideration. It may prove expedient to treat blister copper as heretofore until problems incident to starting the new mine and smelter have been solved.

Developments at the Frood property have been under way since 1924, and $1,600,000 has been expended to Dec. 31, 1927. Estimates indicate that to complete the program, inclusive of mine development, smelter construction, installation of hydro-electric equipment, and additions to the electrolytic refinery at Port Colborne, there will be required during the ensuing three years an expenditure of approximately $12,000,000, which amount is exclusive of the erection of an electrolytic copper refinery at Copper Cliff, if the latter is deemed advisable at a later date.

The nickel refinery at Port Colborne, Ont., was operated continuously to meet market requirements for nickel. The new electrolytic unit ran to capacity throughout the year, and expectations as to quality and cost were fully realized. It is the intention gradually to enlarge the electrolytic refining department and eventually to produce all nickel as electrolytic of the highest quality.

For the fiscal year ended Dec. 31, 1927, there were expended and charged to capital account sums aggregating $1,666,972. The distribution of capital expenditures was as follows: Copper Cliff, $1,172,658; Port Colborne, $47,827; Hydro-electric plant, $275,098; Huntington works, $147,100; sundries, $24,287.

The balance sheet shows that the additions to property account, less recoveries, were $1,666,972, and that $230,602 was written off for dismantlement and charged to reserve fund. The

total property account, after deducting depreciation and depletion of ore reserves, is $53,496,185, compared with $53,424,609 Dec. 31, 1926. Net current assets of $17,638,697 are in excess of last year's figures by $2,107,679.

The following comment on the outlook is from the report:

"Wider distribution of output by efficient and economical methods has been your management's urgent problem. Cost of distribution, inclusive of field service, research, and advertising, has grown more rapidly than costs of production have decreased. Due to this condition, which exists in general business, there is a lowering of the margin of profit which can only be offset by increased sales or by the development of new fields. While in no way deviating from its established policy of sales promotion, your company is intensifying its sales efforts. Additional distributors have been selected and as a necessary adjunct to research, technical publicity, and trade-paper advertising, a certain amount of national advertising has been planned for 1928.

"The company's foreign development activities are now well organized, with branches in Great Britain, France, and Germany. Effort in this foreign field is creating greater interest abroad in nickel, which has already been reflected by greater consumption, and your management believes that foreign sales will show a material increase. In order to support sales promotion, your technical department has broadened the scope of its research and development work in the foundry, allloy steel, and related industries.

"The use of nickel for improving cast iron has grown rapidly during the past year, and this new application of nickel has become an established practice in many foundries. Several new alloy cast irons have recently been developed in the research laboratory. These products comprise high-strength, chilled, no-growth, and corrosion resistant cast irons, all of which contain nickel or nickel and chromium. While the field for these special cast irons is not as extensive as that for foundry gray iron, it is believed to be a potential outlet for a quantity of nickel.

"Technical investigations and surveys on the qualities and uses of nickel alloy steels have shown concrete results. Successful trials of these steels by Canadian and American railroads are encouraging and indicate a new opening of importance for nickel.

"Diversified uses of Monel metal and rolled nickel continue to multiply, with every reason to believe that many current experimental applications will lead to established usage."

The financial position of the company is shown above.

Financial Statement of
The International Nickel Company

Consolidated Profit-and-Loss Statement

For Year Ended Dec. 31, 1927

		1927	1926
Earnings of all properties after deducting manufacturing, selling expense, ordinary repairs and maintenance		$8,861,895	$8,195,141
Other income, less interest on purchase money notes		123,729	167,621
Total income		$8,985,625	$8,362,762
Deduct administrative and head office expense			
General office expense	$603,029		$560,774
Reserved for federal and franchise taxes (estimated provision)	614,498		610,704
		$1,217,527	$1,171,478
Net operating income		$7,768,097	$7,191,283
Deduct			
Orford works property expense	$108,156		$106,154
Depreciation and depletion (provision for)	1,595,395		1,528,861
		$1,703,552	$1,635,016
Profit for the year		$6,064,544	$5,556,267
Dividends, Preferred	$534,756		534,756
Common	3,346,768	3,881,524	3,346,768
Balance		$2,183,020	$1,674,743
Surplus, Jan. 1		16,680,482	15,302,092
		$18,863,503	$16,976,836
Adjustment on disposal of foreign companies		.....	296 353
Surplus, Dec. 31		$18,863,503	$16,680,482

WHITEDELF MINING & DEVELOPMENT COMPANY, operating near Clark Fork, Idaho, shipped ore containing 33,068 oz. of silver and 607,470 lb. of lead in the last five months of 1926. During 1927 shipments aggregated 100,975 oz. of silver and 1,697,953 lb. of lead,

Europe Needs a Zinc "Institute"—Not a Cartel

By the Foreign Correspondent of the American Zinc Institute

A MONTH AGO the London zinc market was hanging around £26 and there was a resistance against any further decline. But in the subsequent pronounced market weakness in lead and in tin the steadiness of zinc could not be maintained, and the price at the close of February was only a few shillings above £25. European stocks have increased moderately in February, although this may possibly be caused by the reluctance of consumers to buy more than their barest needs on a falling market. Thus it does not follow that there has been a definite decrease in European consumption in February, the higher stocks being accounted for by users eking out their supplies.

Since our last survey was written, a strong effort has been made to bring the European zinc interests together for the purpose of creating an all-powerful zinc convention. But, as we previously pointed out, the construction of any large international syndicate will require the patience of a Job and the organizing capacity of a Herbert Hoover. Just as no brain has yet devised a logical scheme for international arbitration, so is it unlikely, in our opinion, that any saviour of the zinc position will arise and retrieve the world situation by voluntary means. A comprehensive scheme embracing European and American zinc smelters has altogether too complex an appearance to promise success. What will probably result is that some of the principal European smelters will enter a syndicate for the purpose of stabilizing prices and curtailing output when necessary. It is argued—and probably rightly so—that a purely European zinc convention will meet the needs of the situation, for the reason that the St. Louis market would be influenced by the London price and would advance in sympathy with any upward trend in London. The idea of the Belgian advocates of a syndicate is that curtailment of production by members of the convention should be ordered whenever the London quotation dips under £25 a ton and follow this or whenever European stocks exceed 25,000 tons. The growing output of high-grade metal has caused some heartburning, but the sponsors of the convention proposal now dismiss this aspect of the matter by explaining that high-grade metal will remain outside the cartel, and syndicate members who produce it should demand a premium of £2 a ton over common zinc.

Personally, we have never varied our view that all the zinc industry requires for its welfare in Europe is an institute conducted on the lines of the American Zinc Institute. Such would disseminate monthly statistics among its members, and also conduct a very necessary campaign of publicity having for its object the development of more uses for zinc. Efforts in the past to induce even the few zinc smelters in Great Britain to create and join a British clearing house of information have met with point-blank refusals.

Our next survey will be dispatched in time for presentation at the annual meeting at St. Louis of members of the American Zinc Institute, and as the first quarter of the year will have elapsed by then the time will be more opportune for envisaging the prospects for the future.

Estimates of the stocks in various countries at various dates are shown in metric tons in the following table:

	1928		1927	
	Mar. 1	Jan. 1	Dec. 1	Jan. 1
United States	37,500	37,000	35,700	19,800
Canada	3,000	2,400	2,500	3,200
Australia	3,300	2,800	2,600	2,400
Germany and Poland	6,400	6,100	6,700	9,500
Belgium	5,800	4,200	4,400	4,000
Great Britain	1,200	1,100	1,500	1,000
Scandinavia	200	200	200	200
Far East	800	600	600	500
Elsewhere	2,900	1,700	1,500	1,500
Totals	61,100	56,100	57,000	43,600

The Market Report

Metal Markets Quiet With Little Change in Prices

New York, N. Y., March 21, 1928—Buying of the non-ferrous metals has been in limited volume in the domestic market during the week ending today. This lull was not unexpected after the brisk activity of the first half of March. The large primary producers of copper continued to maintain their position at 14.125c. Most of the business during the week was done at lower prices, ranging down to 14c., Connecticut. In spite of absence of active buying, lead prices continue firm at 6c., New York, and 5.80c., St. Louis. Zinc is quotably a little stronger than a week ago, but sales are decidedly sparse. Tin experienced a flurry, and Straits is quoted today at 53.75c., an advance of 3½c. from a week ago. Quicksilver has advanced about $4 a flask and silver touched 57½c. Antimony has softened, and the metals of the platinum group are virtually unchanged.

Daily Prices of Metals

Mar.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
15	13.775	50.25	51.00	6.00	5.80	5.625–5.675
16	13.775@13.80	51.00	51.625	6.00	5.80	5.65
17	13.825@13.85	51.75	52.50	6.00	5.80	5.65
19	13.775@13.90	52.125	53.00	6.00	5.80	5.65
20	13.775@13.85	51.50	52.25	6.00	5.80	5.65
21	13.775@13.80	53.00	53.75	6.00	5.80	5.65@5.675
	13.806	51.604	52.354	6.000	5.800	5.652

Average prices for calendar week ending March 17, 1928, are: Copper, 13.821; 99 per cent tin, 50.479; Straits, 51.125; N. Y. lead, 6.000; St. Louis lead, 5.800; zinc, 5.650; and silver, 57.333.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary form of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Mar.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
15	60 7/8	60 7/8	66½	225½	227⅜	19 3/4	20 3/16	25⅛	24 15/16
16	60 15/16	60 15/16	66½	228¾	230½	19¾	20⅛	25	24 13/16
19	61 3/16	61 3/16	66¾	234½	235¾	19⅞	20⅜	24 15/16	24⅜
20	61⅛	61⅛	66⅜	232	232⅞	19 13/16	20¼	25	24 13/16
21	61¼	61¼	66⅜	235	235½	19 15/16	20⅜	24⅞	24 13/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver		Gold London	Mar.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
15	4.87⅜	57¼	26 5/16	84s11½d	19	4.87½	57½	26½	84s11½d
16	4.87½	57⅜	26 7/16	84s11½d	20	4.87¾	57¾	26 7/16	84s11½d
17	4.87½	57½	26 7/16	.....	21	4.87¾	57¼	26⅜	84s11½d
					Avg.		57.375		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cents premium.

Copper Quiets Down

Total sales of copper were not much more than half those of the week preceding. Large primary producers are still holding firm at 14⅛c. delivered in Connecticut, though some fractional shading is reported on metal for delivery at destinations close to the refineries. A fair business for Middle West points has been done at 14¼c., but most of the sales have been made at 14c., 14.05c., and 14.075c., Connecticut, by the sellers in the group that follows the policy of synchronizing sales with intake, as nearly as practicable. Deliveries are for April and April-May, and buyers include both wire-drawers and brass manufacturers. The improvement in the wire business is one of the favorable features of the situation. Domestic as well as foreign consumers are believed to be only partly covered for their April requirements. European business continues fair at the Exporters' price of 14.50c. c.i.f.

Little Change in Lead

The active buying of lead that prevailed during the first half of March has quieted perceptibly. Sales for the week ending today are below normal, though no tendency to cut prices is manifest. The American Smelting & Refining Company continues its contract price in New York at 6c. and the leading interest in the West is quoting 5.80c. No sales below or above these figures have been reported. London has been up and down, the net change for the week being a slight advance. There are few signs to indicate definitely whether the next more will be up or down.

Better Prices for Zinc Looked For

With concentrate selling at $40 per ton in Joplin, zinc smelters cannot possibly make ends meet with slab zinc selling at current levels. If the ore price can be maintained, sellers of metal consequently feel that they will be able to advance their price also. Buyers, on the other hand, are resisting the upward tendency, and transactions are few and far between. Much depends on whether or not the curtailment at the mines, which has been put in effect at Joplin, is continued; or whether the better prices for concentrate will induce mine operators to produce on a larger scale. Today Prime Western for March can be had for 5.65c., whereas April-May delivery commands a premium of from 2½ to 5 points. High-grade continues to be quoted nominally at 7.75c. for spot metal in New York.

Tin Active at Higher Prices

The week ending today has been the most active of the present year in the tin market. Reports that the Steel Corporation had purchased a large quantity of spot tin stimulated the market on this side, and other consumers and dealers bought freely. Today's price is 53.75c. for prompt Straits, with little difference in quotations for forward deliveries. Tin of 99 per cent grade is still scarce and the price is nominal.

Silver Is Higher

The tendency of silver during the last week has been slightly upward, the New York price touching 57½c. on March 17 and 19, the highest quotation since Jan. 12. Limited offerings and moderate buying for India and China have been the supporting features of the market, although with less interest shown today the quotation has eased off slightly to 57¼c.

Mexican Dollars (Old Mexican pesos): March 15th, 43⅞c.; 16th, 44c.; 17th and 19th, 44⅛c.; 20th, 44c.; 21st, 43⅞c.

Foreign Exchange Steady

Sterling, as well as the other foreign exchanges, has been steady. Closing cable quotations on Tuesday March 20 were: francs, 3.93¾c.; lire, 5.28½c.; and marks, 23.92c. Canadian dollars are ⅛ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

ALUMINUM—Per lb., 98 or 99 per cent grades, price of leading interest, 24.30c.; outside market, 23.90@24.30c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, for all positions, 10⅛c.

Cookson's "C" grade, spot, 15⅜c. Needle antimony nominally 7¼c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 11¼c.

BISMUTH—Per lb., New York, in ton lots, $2.10. Smaller lots, $2.25 and up.

IRIDIUM — Per oz., $295@$320 for 98@99 per cent sponge and powder. Market dull, prices largely nominal.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $50@$52. Small lots bring up to $56. Absolutely no activity in market.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $80. Dealers and refiners quote the trade for refined metal, per oz., cash, $75@$79. Market very dull.

QUICKSILVER — Per 76-lb. flask, $123.50@$125, depending on quantity. San Francisco wires $123.

Cable advices from Europe are to the effect that the Italian and Spanish producers of quicksilver have come to an agreement whereby the price is to be pegged at £22 10s. f.o.b. mines. After paying freight, insurance and the duty of $19 per flask this is equivalent to about $125 in the United States. This has stimulated sudden interest on the part of domestic consumers. Some dealers who have realized a good profit have sold at under this parity, but it is improbable that the market will settle below $125 if the reports are authentic.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of March 3.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn. c.i.f. North Atlantic ports, minimum 47 per cent Mn: 35@38c. Caucasian, washed, 53@55 per cent, 38@40c. Chemical grades unchanged from quotations in the March 3 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite, $10.25@$10.50. Western scheelite, $10.50@$10.75. Market dead; prices nominal.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the March 3 issue.

Zinc $2 Higher—Lead Unchanged

Joplin, Mo., March 17, 1928

Blende	Per Ton
High	$37.80
Premium blende, basis 60 per cent zinc	$40.00@ 41.00
Prime Western, basis 60 per cent zinc	38.00@ 40.00
Slimes and fines, 60 per cent zinc	34.00@ 37.00
Average settling price, all zinc	34.91
Galena	
High	$77.60
Basis 80 per cent lead	72.50
Average settling price, all lead	76.32

Shipment the week: Blende, 9,883; lead, 894 tons. Value, all ores the week, $413,240.

The price of Prime Western grades of zinc concentrate was advanced to $40 basis early in the week, lowered to $38 Saturday morning, and again advanced before the close of the day to $40 before a suitable tonnage was secured. A buyer's estimate of the enforcement of the restriction movement places production at approximately 3,000 tons less than the 12,400 tons produced last week, or around 25 per cent lower.

Sellers are not accepting the base offering for lead for any of the reserve tonnage of about 11,000 tons.

Platteville, Wis., Mar. 17, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent	$40.75
Lead Ore	
Lead, basis 80 per cent lead	$72.50

Shipments for the week: Blende, 636 tons; lead, none. Shipments for the year: Blende, 7,834 tons; lead, 560 tons. Shipments for the week to separating plants, 935 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the March 3 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic). —Per lb., 4c. A few good sales made.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the March 3 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or c.i.f. port of entry, $100 quoted for second quarter, 1928. Spiegeleisen, 19@21 per cent, $30@$32 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 92@95c. f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the March 3 issue.

Metal Products

ROLLED COPPER—Sheets, 22¾c.; wire, 16@16¼c. per lb., f.o.b. mill.

LEAD SHEETS — Full rolled, 9¾c. per lb.; clipped, 10c.

NICKEL SILVER—29¼c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL — Dimension sheets, 19¾c. per lb.; rods, 16¾c. per lb.

ZINC SHEETS — 9½c. per lb., f.o.b. works.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of March 3.

Iron, Steel, and Coke

Iron—Per gross ton, Valley furnaces, Bessemer. $17.50; basic, $17; No. 2 foundry, $17.25.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per pound, 1.85@1.90c.

Coke—Per gross ton, Connellsville furnace, contract, $2.85@$3; spot, $2.60@$2.75. Connellsville foundry, contract, $3.75@$4.25; spot, $3.75@$4.25. By-product coke, Ohio and Kentucky, $7.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended March 17, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	56⅛	54	55⅛	Ja.14, Fe.20 Q	0.75
Arcadian Consol.	Boston	...	...	5⅛	...	...
Ariz. Com'l	Boston	4⅛	3⅞	4	Ja. 19, Ja. 31	0.25
Cal. & Ariz.	New York	95⅜	91⅛	94	...	...
Calumet & Hecla	Boston	21⅛	20⅜	21⅛	No.30, De.15 Q	0.50
Cerro de Pasco	New York	63	61⅛	62⅛	Ja.12, Fe.8 Q	1.00
Chile Copper	New York	38⅛	37⅛	38	Ma. 2, Ma. 30Q	0.62
Con. Coppermines	N. Y. Curb	8⅛	8	8⅛	...	...
Copper Range	Boston	15⅛	14⅛	15⅛	Ap.2, My.2, A	1.00
Crystal Copper	BostonCurb	*52	*45	*48	...	...
East Butte	Boston	2	1⅛	1⅛	Dec. 1919	0.50
Granby Consol.	New York	43	42	42⅞	Jn.15 Jy. 1 Q	1.00
Greene Cananea	New York	134⅛	128⅛	128⅛	Nov., 1920	0.50
Howe Sound	New York	45⅞	44	45	De.31, Ja.16, Q	1.00
Inspiration Consol.	New York	19⅛	18	18⅛	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	...	...	2⅛	...	...
Isle Royale	Boston	12⅛	12	12	Fe. 28, Ma. 15	0.50
Kennecott	New York	82	80⅛	81⅛	De. 2, Ja 3 Q	1.25
Magma Copper	New York	49⅜	46	49⅛	Ma.31, Ap.16Q	0.75
Mason Valley	N. Y. Curb	1⅜	1⅜	1⅜	...	...
Miami Copper	New York	18⅛	18	18	Fe.1, Fe.15, Q	0.37½
Mohawk	Boston	50⅛	49⅛	50⅛	Ja. 28, Ma. 1 Q	1.00
Montana-Idaho	Spokane	*44	*41	*42	...	...
Mother Lode Coal	New York	3⅛	3	3⅛	De.16, De.31	0.25
Nevada Consol.	New York	20⅛	19⅛	19⅛	Ma.16, Ma.31 Q	0.37½
New Cornelia	Boston	27	26	26⅛	Fe. 3, Fe. 20 Q	0.50
Noranda	N. Y. Curb	19⅜	18⅛	18⅜	...	...
North Butte	Boston	1 1/16	*99	*99	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*85	*80	*81	Sept. 1926	0.03
Old Dominion	Boston	9⅛	9	9	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	...	...	121⅛	De.17, Ja.3 Q	1.50
Quincy	Boston	13	12	12⅛	March, 1920	1.00
St. Mary's Min. Ld.	Boston	27⅛	25⅛	27⅛	Fe.10, Ma.10	2.00
Seneca Copper	New York	2⅛	2	2	...	...
Shattuck-Denn	N. Y. Curb	15	13⅜	14⅜	...	...
Tenn. C. & C.	New York	11	10⅛	10⅛	Fe.29, Ma.15, Q	0.12½
United Verde Ex.	N. Y. Curb	20⅛	19⅛	19⅛	Ja.4, Fe.1 Q	0.50
Utah Copper	New York	...	...	143	Ma.16, Ma.31 Q	1.50
Utah Metal & T.	Boston	1⅜	1⅜	1⅜	Dec., 1917	0.30
Walker Mining	Salt Lake	*84	*72	*73	...	...
NICKEL-COPPER						
Internat. Nickel	New York	98	88⅛	93	Ma.15, Ma.31Q	0.50
Internat. Nickel pfd.	New York	...	...	112⅛	Fe. 17, Ma. 1 Q	0.62½
LEAD						
Gladstone Mtn.	Spokane	8½*	*8⅛	*8⅛	June, 1927	0.005
National Lead	New York	128	126	128	Ma.16, Ma 31 Q	1.25
National Lead pfd.	New York	139	139	139	Ap.23, My.1 Q	1.50
National Lead,pfd. B	New York	113⅛	109	113	...	...
St. Joseph Lead	New York	39⅛	37	37⅛	Ma.9,Ma.20, QX	0.75
ZINC						
Am. Z. L. & S.	New York	23	15⅛	20⅜	May, 1917	1.00
Am. Z. L. & S. pfd.	New York	84	71⅛	81⅛	Nov., 1920	1.50
Butte C. & Z.	New York	6	5⅛	5⅛	De. 9, De. 24	0.50
Butte & Superior	New York	10⅛	9⅞	10⅛	De.16, De.31 Q	0.50
Callahan Zn-Ld.	New York	2⅛	1⅛	2⅛	Ma. 14, Ma. 31	0.50
Consol.Lead&Zinc'A'	St. Louis	11⅛	11	11	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	17⅛	15⅛	16⅛	No.15, De.1 Q	0.40
Eagle-Picher pfd.	Cincinnati	105	104	104	Jn.30, Oc.15 Q	1.50
New Jersey Zn.	N. Y. Curb	195	191	195	Ja. 20, Fe. 10	2.00
Treadwell-Yukon	Toronto	29	26	27⅛	...	...
United Zinc	N. Y. Curb	...	...	25	...	...
Yellow Pine	Los Angeles	*30	*30	*30	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	4⅛	3⅞	3⅞	...	...
Argonaut	Toronto	*21⅛	*14⅛	*16⅛	...	...
Barry-Hollinger	Toronto	1.25	1.08	1.23	...	...
Central Manitoba	Toronto	1.51	1.40	1.42	...	...
Con.W.Dome L.new.	Toronto	*13	*12	*12	...	...
Cresson Consol. G.	N. Y. Curb	2 3/16	2 1/16	2 1/16	Ma.31, Ap.10 Q	0.10
Dome Mines	New York	11	10⅛	10⅛	Ma. 31, Ap. 20Q	0.25
Golden Cycle	Colo.Springs	†1.75	†1.74	...	Fe.29, Ma.10 Q	0.04
Gold Hill	Toronto	*29	*24	*24⅛	...	...
Holliuger Consol.	Toronto	17.45	16.95	17.05	Ma. 7, Ma. 24	0.10
Homestake Mining	New York	73⅛	73	73⅛	Ma.20,Ma.26 Q	0.50
Kirkland Lake	Toronto	2.14	1.92	2.06	...	...
Lake Shore	Toronto	24.25	23.75	23.75	Ma.1,Ma.15 QX	0.20
McIntyre-Porcupine	New York	28⅛	28⅛	28⅛	Fe. 1, Ma. 1 Q	0.25
Portland	Colo.Springs	†*29	†*23	...	Ap.6, Ap.15, Q	0.02
Rand Mines	New York	...	...	40⅛	Au.22-29 Am.Sh.1	1.52
Sylvanite	Toronto	3.45	3.30	3.30	...	...
Teck-Hughes	Toronto	8.90	8.60	8.75	Fe.1, X	0.15
Tom Reed	Los Angeles	*20	*20	*20	Dec., 1926	0.02
Tough-Oakes	Toronto	*62	*56	*56	...	...
United Eastern	N. Y. Curb	*54	*53	*53	July, 1924	0.05
Vipond Cons.	Toronto	*56	*49	*50⅜	Apr.1, Apr.15	0.03
Wright-Hargreaves	Toronto	5.30	5 10	5.10	Ja. 17, Fe. 1	0.05
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	26⅛	24	24	...	...
Con. Cortez	N. Y. Curb	...	...	*23	...	...
Dolores Esperanza	N. Y. Curb	...	...	*31	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb	...	...	...	...	...
Lucky Tiger-Com.	Kansas City	†8.10	†7.80	...	Ma.10, Ma. 20X	0.07
Premier Gold	N. Y. Curb	2⅜	2 3/16	2 1/16	Ma. 15, Ap. 4	0.08
Tonopah Belmont	N. Y. Curb	...	...	1⅜	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*15	*12	*15	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	4⅛	4	4	Se.20, Oc.21	0.07½
West End Consol.	N. Y. Curb	...	...	*5	Mar., 1923	0.05
Yukon Gold	Boston Curb	*50	*50	*50	June, 1918	0.02
SILVER						
Beaver Consol.	Toronto	1.64	1.58	1.62	May, 1920	0.03
Castle-Trethewey	Toronto	*60	*58⅛	*60	...	...
Coniagas	Toronto	4.85	4.75	4.85	May, 1924	0.12½
Keeley	Toronto	*60	*56	*60	Ma. 1, Ma. 15	0.04
Lorrain Trout Lake	Toronto	...	...	*60	July, 1925	0.05
Mining Corp. Can.	Toronto	3.80	3.55	3.55	Ja.10, Ja.25	0.15
Nipissing	N. Y. Curb	5⅛	4⅞	4⅞	Ma.31, Ap.20 Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	4⅛	3⅞	4⅛	Ma. 25,Ap.4,QX	0.12½
Bingham Mines	Boston	52⅛	51⅛	51⅛	Ma. 22, Ap. 5 Q	1.00
BunkerHill&Sullivan	N. Y. Curb	154⅛	150	152⅛	Fe.29, Ma.5 QX	0.75
Cardiff M. & M.	Salt Lake	*62	*61	*61	Feb 5, 1927	0.10
Chief Consol.	Salt Lake	4.10	3.78	3.90	Ja.10, Fe.1 Q	0.10
Consti'nMng.&Mill'g	Spokane	*23	*10	*20	...	...
Erupcion	Boston Curb	*25	*23	*25	De.17, Ja.3 Q	0.07½
Eureka Lily	Salt Lake	1.85	1.67½	1.85	...	...
Federal M. & S.	New York	...	...	140	Jn.25, Jn.29 Spec.	$10
Federal M. & S pfd.	New York	95	94⅛	94⅛	Fe.24 Ma.15 Q	1.75
Hecla Mining	N. Y. Curb	16⅛	16	16⅛	Fe.15, Ma.15 Q	0.25
Highland-Surprise	Spokane	*13⅛	*11	*13	...	...
Iron King Mining	Salt Lake	*63	*60	*60	...	...
Keystone Mining	Salt Lake	*35	*32½	*35	Au. 12, Au. 26	0.07½
Lucky Jim	Spokane	...	...	*40⅛	...	...
Mammoth Mining	Salt Lake	1.50	1.40	1.50	Jn.10, Jn.20 Q	0.05
North Lily	Salt Lake	6.50	5.75	6.40	...	...
Park Utah	New York	11	10⅛	10⅛	Ma. 15, Ap. 15 Q	0.20
Plutus Mining	Salt Lake	2.20	2.20	2.20	Oc. 25, No. 10 Q	0.10
Silver King Coal	Salt Lake	11.00	10.75	10.87½	Ma. 20, Apr. 2, Q	0.25
Silversmith	Spokane	*19⅛	*18	*19⅛	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*47⅛	*35	*46	...	...
Sunshine M. Co.	Spokane	1.40	1.20	1.30	Fe.10,Fe.20	0.02
Tamarack-Custer	Spokane	*99	*95	*98	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.62½	12.75	13.62½	Ma.21, Ma.29 Q	0.30
Utah-Apex	Boston	4⅛	4	4⅛	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	62⅛	58⅛	61⅛	Se. 2, Oc. 1	1.75
Cleveland-Cliffs Iron	Cleveland	125	111	122	Ja.13, Ja.25. Q	1.00
Colorado Fuel & Iron	New York	83⅛	72⅛	82⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	23	21⅛	22⅛	Dec. 6, Dec. 28	0.75
Inland Steel	New York	51⅛	50	51	Fe.15 Ma.1 QX	0.66⅔
Republic I. & S.	New York	62⅛	60⅛	61	Fe. 15, Ma. 1 Q	1.00
Republic I. & S. pfd.	New York	109	108	108	Ma. 15, Ap. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	132	128	128	De. 10, De. 20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	...	...	119	De. 20, Ja.3 Q	1.75
U. S. Steel	New York	149⅛	144⅛	147⅛	No. 30, De. 30 Q	1.75
U. S. Steel, pfd.	New York	140⅜	139⅛	140⅛	Oc.30, No. 29 Q	1.75
Virginia I. C. & C.	New York	...	...	34	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York	...	...	62	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol.	New York	27⅜	27⅛	27⅛	Jn. 26, Jn.30	1.45
So. Am. G. & P. New.	N. Y. Curb	3⅛	3⅛	3⅛	...	...
Alum. Co. of Amer.	N. Y. Curb	126⅛	125	125⅛	...	...
Alum. Co. ofAmer.pf.	N. Y. Curb	108⅛	107	108	Ma. 15, Ap.1 Q	1.50
Vanadium Corp.	New York	96	80⅞	90	Fe. 1, Fe. 15 Q	0.75
Patino M. & E.	New York	27	25⅛	25⅛	De. 31, Ja. 14	4s.
ASBESTOS						
Asbestos Corp.	Montreal	30⅛	29	29⅛	Jan., 1926	1.50
Asbestos Corp. pfd.	Montreal	91⅛	91	91	Ma.31, Ap.16 Q	1.75
SULPHUR						
Freeport Texas	New York	89	78	84	Ap.14, My.1 QX	1.75
Texas Gulf	New York	78⅛	73⅛	76⅛	Ma.1, Ma.15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	40⅛	39	40⅛	Fe.18, Ma.1 Q	0.75
Amer. Metal, pfd.	New York	121⅛	116⅛	120	Fe.18, Ma.1 Q	1.75
Amer. Sm. & Ref.	New York	178⅛	172	176⅛	De.31, Fe. 1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	...	...	132⅛	De.31, Ma.1 Q	1.75
Consol. M. & S.	Montreal	269	267	269	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	165⅛	155⅛	161⅛	Ja.3, Ja. 17	1.00
U. S. Sm. R. & M.	New York	40⅛	39⅛	40⅛	Ja. 6, Ja. 14 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	53	53	53	Ja. 6, J3 14 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED MARCH 6, 1928

Name	High	Low	Last	Date	Last Div. Amount
Aramayo Mines (25 frs.)	75/—	72/6	72/6	Feb., 1928	5 p.c. (†)
British Platinum (£1)	—/1⅛	—/1⅛	—/1⅛	Feb., 1925	2½ p.c.
Burma Corpn. (10 rupees)	12/9	12/3	12/7½	Jan., 1928	6 annas*
Bwana M'Kubwa (5s)	4/6	4/3	4/6	...	...
Camp Bird (2s)	4/1½	3/7½	3/10½	...	...
El Oro (£1)	4/9	3/11	4/6	Nov., 1924	2½ p.c.*
Esperanza (10s)	—/1	—/1	—/1	...	...
Frontino & Bolivia (£1)	14/9	13/9	14/9	Jan., 1928	5 p.c.
Mexican Corpn. (£1)	10/9	9/1½	10/6	...	...
Mexico Mines of El Oro (£1)	32/6	30/—	32/6	Dec., 1926	3½ p.c.*
N'Changa Copper Mining	12/6	12/—	12/—	...	...
Oroville Dredging (£1)	4/—	3/9	4/—	Dec., 1923	3½ p.c.
Ouro Preto (£1)	2/6	2/3	2/3	May, 1925	2½ p.c.
Rhodesian Congo Border (£1)	23/1½	19/9	21/3	...	...
St. John del Rey (£1)	10/6	9/9	10/3	May, 1927	3½ p.c.
San Francisco Mines (10s)	28/—	26/3	28/—	Jan, 1928	25s.
Santa Gertrudis (£1)	16/6	15/7½	16/3	Jan., 1928	7½ p.c.
Selukwe (2s. 6d.)	8/3	7/—	7/9	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	1/7½	1/4½	1/6	Nov., 1917	75 p.c.
Tanganyika (£1)	72/9	60/—	64/4½	Aug., 1927	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	‡8.000	7.667½	7.937½	July, 1927	182.60 (‡)

* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.